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INTRODUCTION

With the increasing demand for desirable homesites, suburban and rural land development is rampant throughout the western United States. In Montana, not only is water endowed land in high demand, but view-property, wooded lots, and wetlands are also undergoing significant land subdivision. Notable environmental degradation often parallels land development schemes. In order to achieve proper design, an extensive resource inventory and development plan is a necessary base upon which to build.

Bridger Canyon is predominantly an agricultural valley enriched with trout streams, rolling pastures and forested foothills--characteristic of mountain environments. Throughout the entire year, the area is enjoyed by an increasing number of residents and tourists. For the past twenty years, Bridger Canyon has experienced a period of accelerated demand for a variety of land uses. In order to preserve the natural, physical character of the canyon, and to ensure orderly growth, a general plan and development guide for Bridger Canyon has been established.

A development plan for Bridger Canyon was originally petitioned by area residents. Concerns focused on the growth of the ski area and on the potential traffic capacity of the canyon road. Additional concerns led to the formation of the Bridger Canyon Property Owners Association. The underlying objective was to form a plan favoring the conservation of natural resources, preservation of open space and agricultural uses, and limited, controlled growth. The Property Owners Association selected Murray and McCormick, Inc., a planning-engineering firm from Sacramento, California to create a general plan and development guide for Bridger Canyon.

The General Plan and Development Guide for Bridger Canyon was officially adopted in 1971. During July of the same year, the Bridger Canyon Zoning District was created by resolution of the Board of County Commissioners. In October, 1972, the Bridger Canyon Zoning Regulation, pursuant to R.C.M. 16-4101, was incorporated into the general plan. In accordance with M.C.A. 76-2-106, the above zoning Regulation and Plan have undergone periodic amendments.

The following General Plan and Development Guide embodies a complete physical and cultural resource analysis, economic and demographic data, and land use development standards. In total, the plan offers guidelines to manage development impacts on the natural environment of Bridger Canyon.

Large resource information maps are available for inspection at the Gallatin County Subdivision Review Office. The Construction Development Guide is available at the County Planner's Office or with the Bridger Canyon Property Owners Association.

GENERAL PLAN OBJECTIVES

The primary objectives of this plan are to guide future physical growth within Bridger Canyon and to protect the natural beauty and agricultural open space character of the area. In order to provide the greatest opportunities for orderly growth and to retain the environmental nature, it is essential to give intelligent forethought to the design of the area.

This plan recognizes Bridger Canyon as:

- A desirable place to live and an area with an increasing growth rate.
- A place of growing recreational use and demand.
- An area where forest lands will continue to exert influence.
- A place demanding protection of its environmental beauty and agricultural open space.
- An area with strong citizen interest favoring conservation of natural resources; preservation of open space and agricultural usage; and limited, controlled growth compatible with the natural environment.

This plan has the majority support of the residents and property owners of Bridger Canyon. This plan is intended to be used as a guide both to government agencies and private enterprise. As the pressures of growth continue, the canyon residents will find it necessary to guide this growth in an orderly and logical manner through the planning and zoning process.

The Bridger Canyon property owners are interested in a general plan indicating future land uses, population density, major roads, public facilities, and suggested conservation measures required to maintain a balance between natural resources and population growth. The following includes the property owners' list of goals and development standards to the General Plan:

PROPERTY OWNERS' GOALS

1. To maintain continuous coordination and cooperation between citizens and public and semi-public agencies operation in and around the Canyon.
2. To secure increased citizen participation in the planning process and, if necessary, to work for legislation which will offer protection from the adverse effects of urbanization.
3. To preserve and protect those environmental qualities that are resources of the zoned area.
4. To maintain high water quality standards through constant monitoring.
5. To encourage agricultural land preservation and the needs of the rancher.
6. To disseminate information on good logging practice and silviculture so that timber resources can be conserved.

7. To set limits on areas of high intensity recreational use based on access, sensitivity of surrounding uses, influence on water quality, traffic generation, fire hazard, and environmental effects.
8. To insist on attention to vegetation, sanitation, wildlife habitat, erosion, and public safety concerns for new development.
9. Elements of community design (roads, utilities, etc.) should be planned to include environmental factors in addition to usual safety and engineering considerations.
10. New residential development will be encouraged in low density tracts or clusters.
11. Residences, commercial facilities, public buildings, street signs, etc., shall be designed to fit the rural character of the area.

HISTORY AND DEVELOPMENT

Along the northern edge of the Gallatin Valley rests Bridger Canyon, a long and narrow valley surrounded by snow covered mountains and carpeted with natural sage and grassy floored lowlands.

Approximately 100 million years ago, mountains began to rise in the valley and the ancient Cambrian seas were forced out of Montana. Volcanoes erupted and rocks pushed their way up to form mountains, including the Bridger range. The low lying valley floors were covered with silt and sediment. Mastodons, rhinoceros, and early variations of horses and bison roamed the area. Later, ice-age glaciers smoothed out mountains, and streams eroded the area into its present form. Today, only occasional earthquakes and hot springs remind us of the volatile activities which contributed to the creation of this attractive area.

By the time the first natives viewed the Canyon, it looked much as it does today. According to early treaty records, this game-rich region was a crossroads for several Indian tribes and served primarily as a common hunting ground.

In the summer of 1806, Captain William Clark, on his return trip from the Pacific, while passing through the Gallatin Valley with the Indian guide Sacajawea, commented on the abundance of elk, deer, antelope and numerous beaver. Fur trappers and traders, including John Colter, Peter Skene, John Bozeman, and Jim Bridger, for whom the canyon is named, soon began to sojourn to the area. The fur trade was an ephemeral era. Trappers and traders explored the region and blazed trails, which would carry settlers, but few remained behind. Permanent white settlement in the area had to wait until the discovery of gold in southwestern Montana valleys and the resultant regional market for agricultural goods.

The Gallatin Valley, with the best reputation as a prospective farming area, kept pace with the agricultural development which paralleled the influx of early gold seekers. In the late 1860's, the Valley had three flour mills and was the territory's granary. As more and more land in the valley was occupied, settlers turned towards the Bridger Canyon with greater interest. Agricultural activities were the chief means of livelihood for most of the canyon's residents.

By the time Bridger Canyon entered the twentieth century, two schools were in operation and community spirit ran high. Inter-action in social, religious, and educational activities was at its peak during the years prior to the development of roads satisfactory for year-round use and prior to the loss of the community schools, which had served as a nucleus which held canyon residents together.

Improved transportation facilities continued to unlock the agricultural bounty of Gallatin County. Rich soils enhanced by irrigation greatly expanded farming and livestock production, earning the valley the title of "Egypt of America."

By 1949, increased participation in winter recreation led to Bridger Canyon's first ski lift. Slowly plans were made to develop a ski hill for Bozeman and area residents. By 1957, an upper tow of 1500 feet with a vertical rise of 900 feet had been added. Tickets that season were \$2.00 per day for adults and \$.50 per day for children. Bridger Bowl was on its way to becoming one of the best deep

powder ski areas in the Northwest. In addition to alpine skiing, areas located near Bridger Bowl are developing as the regional center for cross-country ski enthusiasts.

From these origins, Bridger Canyon has become the site of many different pursuits--forestry, recreation, and ranching. With a shifting emphasis to recreation and pressures from nearby urban areas for the use of its vast natural resources, Bridger Canyon is faced with a development potential unrealized in its history. By protecting the land, air, and water of the entire canyon through implementation of a program for planned growth, property owners hope to retain the pristine atmosphere of this beautiful location and to maintain an environment in which man and nature can peacefully co-exist.

PHYSICAL DETERMINANTS

LANDFORM: The surface form of the physical landscape is an underlying determinant for all aspects of the general plan. Topography, along with slope analysis, water availability, vegetative cover, geology, soil interpretations, and climate conditions, further delineate the constraints on development.

TOPOGRAPHY: Bridger Canyon is approximately fifteen (15) miles long and eight (8) miles wide. As shown on the contour map, Bridger Canyon is bounded by the ridge-like Bridger Range to the West and by lower peaks to the South and East. The lowest point in the zoning district is 4,800 feet above sea level, one (1) mile West of the U.S. Fish Culture Development Center. The highest point is Saddle Peak at 9,162 feet, over-looking the ski area. On average, the surrounding mountain ridges rise 2,400 feet to 2,700 feet above the canyon floor.

Three (3) roads provide access through passes in the highlands surrounding the canyon. Bridger Canyon Road enters from the City of Bozeman to the South and continues through the Northern boundary of the zoning district. Jackson Creek Road provides access from the Southeast, while Kelly Canyon Road cuts South through a low spot in the Bridger Range connecting to the frontage road, Old Highway 10.

Recommendations: Mountainous topography will limit the number of access routes in and out of the Canyon, and also inhibit road building generally in all but flatter slopes. Land uses generating additional automobile trips should be limited in scale by traffic capacity of present routes. Developable land above 6,000 feet may pose problems for access.

SLOPE ANALYSIS: Slope conditions within Bridger Canyon are among the most important factors conditioning development. The slope classification map divides the study area into four (4) major classes. Categories used are: 0-10%; 10-20%; 20-30%; and over 30% (1) This map depicts areas which, due to steepness of terrain, will limit or prohibit development.

The small portions of level or gently sloping land (up to 10%) in the canyon will possibly necessitate utilization of steeper land. Areas with slopes up to 30% can be satisfactorily developed provided that there are no environmental restrictions and great care is taken during construction.

Increased hazards to the environment are present when slopes between 20% and 30% are subject to development. Construction projects in this category must proceed under strict standards and control. Roads should not be constructed on lands having slopes in excess of 30% because of excessive scarring caused by earth construction work. Extreme erosion of exposed soils in deep cuts and fills, related drainage problems caused by high velocity run-off, and grade and access problems related to conventional road systems are some problems associated with development on steep slopes. In addition, questions have been raised regarding the stability of soils and rock in areas having slopes over 30%. Development should not be allowed on this steeper land.

Recommendations: Slopes in excess of 30% should be retained in their natural condition. Environmental considerations may further concentrate development to more level areas.

VEGETATIVE COVER: Bridger Canyon has an abundance of vegetative cover. Steeper sloping lands are more densely covered by coniferous forests. Gallatin National Forest lands surround the canyon to the West and East. Vegetation type varies due to climatic differences from the canyon floor to the timber highlands.

The tree canopy consists primarily of Lodgepole Pine and Douglas Fir, interspersed with shrubs and open meadows. Higher elevations to the West and East have greater tree cover than lower elevations.

Upper elevations in the Southeast and fragmented sections of the South and Southwest contain belts of barren areas. The canyon floor consists of various Western grasses, forbs, and shrubs. Riparian vegetation--that belonging to a natural watercourse--banks around both Bridger and Jackson Creeks.

Recommendations: Development is encouraged to locate in areas of good tree cover. Intrusion of housing on flat, open lands will require special treatment to maintain the present character of the valley. Retention of vegetation as an environmental resource is important in preserving and maintaining watershed protection and scenic, environmental, and recreational values. It is recommended that timber cutting be in accordance with timber harvest guidelines addressed in the General Plan.

GEOLOGY: The geology map indicates geological information for the entire Bridger Canyon area. Sedimentary and metamorphic formations characterize the planning area slopes, while alluvial and landslide deposits typify flatter portions of the canyon floor.

From a planning perspective, three features are important: economic and intrinsic values; stability of a formation; and significant areas of faulting. Urban developments should be limited to slopes less than 30% on any formation except alluvial or landslide deposits. In the latter cases, only slopes less than 10% are considered advisable for developmental uses.

The older rocks in the area have undergone a large amount of distortion and deformation resulting in numerous and complex folds, faults and fractures. More specifically, the faulting and folding include normal faults, reverse faults, thrust faults, and overturned thrust faults. We would expect to find fairly large gouge zones associated with the faulting where rock strength will be markedly different from the surrounding rocks.(2)

Faulted areas are indicated in their approximate locations on the geology map. Areas of significant faulting should also be avoided when siting structures such as roads, buildings, or utilities.

SOIL INTERPRETATIONS: Soils in Southwestern Montana support a mixture of grass and conifer vegetation. This mountain and foothill zone lies below the subalpine fir forests of the high

mountains and above the valley bottoms. The area is primarily forested but most of the soils are rich in organic matter because of grass understory or forest invasion of former grassland.

Soils and vegetation commonly often change with direction of slope. South slopes are typically grass covered mollisols and adjacent North slopes are forested inceptisols or alfisols. Bridger Canyon soils are argic Cryoborolls formed in alluvium and glacial till of various rock types.

General descriptions of soils in specific areas are useful in predicting the potential problems which might be encountered during private and public construction work.

Even though severe soil limitations can often
be overcome through engineering and technology,
it is our purpose to encourage careful con-
sideration...before soils are put to uses
which are not suited to their natural properties.
Theoretically, any soil can be used for any
purpose--practically, the costs may be great.(3)

The soil classifications map shows only those soils found in the lower elevations of Bridger Canyon. The generalized soil classifications on this map indicate most of the soils suitable for croplands to be in the lower sections of the canyon floor. Additional soils suitable for cultivation are located along the stream channels that are tributary to Jackson Creek. Bridger Canyon soils are used for range, dryland, and irrigated production of alfalfa and small grains.

Native vegetation includes mainly bluebunch wheatgrass, Idaho fescue, rough fescue, prairie junegrass, lupine and silver sagebrush.

Gallatin silty clay loams, where fairly well-drained, will handle alfalfa, grain, timothy, hay and other grasses. The swampy phase of this soil is best suited for grazing. Soils in the immediate vicinity of these streams labelled Gallatin silty clay loam, Gallatin silt loam, and Gallatin silt loam swampy phase have severe limitations in their adaptability to urban development due to high water table and frequent flooding.

Soils labelled Bridger silty clay loam, Bridger loam, and Bridger gravelly loam have severe limitations with respect to cropping where slopes exceed 10%. They are suitable for urban development on slopes up to 15%. River wash soils indicated on the map are best adaptable for grazing and wildlife. "Gumbo" or sticky soils prevail in the canyon during wet ground conditions.

Supplementary detailed information on Gallatin Series, Bridger Series and Havre Series Soils are listed in Appendix A. Estimated soil limitations for selected uses and soil development guidelines for the Bridger Canyon soils are listed in Appendix B and C, respectively.

Recommendations: Subject to soil limitations discussed in Appendix C, urbanization could take place on the Bridger soils where the slopes range between 0% and 15%. Soil limitations as outlined in the Appendix are for general planning. All soil differences which occur in the field cannot be shown on a general soil map. Therefore, on-site investigation is needed for specific design and

construction. Erosion control measures are necessary in conjunction with any development within the canyon. All other soils shown on the map would best be retained for agricultural uses or as areas best suited for wildlife habitat. This leaves approximately 20% of the total land area suitable for development.

CLIMATIC CONDITIONS

Due to its geographic setting, Bridger Canyon experiences a variety of climatic phenomenon. While lacking comprehensive data on all climatic conditions, opinions of local residents were solicited to give a picture of local weather patterns. The resulting Meso-climate map indicates primary and secondary comfort zones based upon sunshine, air flows, wind directions, and snowfall limitations for the entire study area.

PRECIPITATION: Annual rainfall values for Bridger Canyon indicate varying amounts of rainfall from location to location due to local topographic changes. There is a defined wet-dry season relationship. The dry season extends through both July and August. Most of the rainfall occurs during the months of June and September, with snow falling intermittently from November through March.

The precipitation varies between an estimated average of 20-40 inches annually. The map on Meso-climatic conditions indicates the rainfall and snowfall precipitation for different elevations within the canyon.

Flooding occurs annually during spring runoff on approximately 30-60 acres in the lower canyon; otherwise, it is not a normal problem.

Few of the ranchers in the canyon use irrigation practices on their land, even though most have the right to do so. The Gallatin County Agent considers Bridger Canyon precipitation sufficient to classify the area nearly equal to irrigated ground. Detailed information on Bridger Canyon water supplies and water rights can be obtained from the "Bridger Bowl County Water and Sewer District Report", January, 1978.

SNOWFALL: Snowfall in the canyon affects wintering areas for wildlife; snow removal costs on highways, streets, and parking lots; and suitability for housing developments. Average annual snowfall in inches for the Bridger Canyon area is shown in Appendix D on the Gallatin River Drainage annual snowfall map. Data for the map was compiled from snow survey records and National Weather Service Climatological Data. Snowfall data for Bridger Canyon is desired by area developers and managers of winter sports areas.

With expanding population pressures in Bridger Canyon, construction activity is increasing in the foothill and mountain areas. Mountainous areas accumulate sizable amounts of heavy snowfall during the winter season and it is imperative that homes, bridges, recreation facilities, and other structures be designed to withstand the heavy snow loads. To assist with the design of structures in the Bridger Canyon area, snow loads for a 50 year frequency have been determined from snow survey data.(4) The 50 year snow loads are calculated to represent the maximum snow load on the ground which can be expected to occur once in 50 years. As a rule of thumb, the conventionally pitched roof load may be estimated as 0.8 times the ground snow load.

In some areas, special consideration needs to be given to wind and exposure, in addition to roof configuration. Snow drifting will generally present more of a problem than snow depth. The

snowloads map in Appendix E shows ground snow loads for the Gallatin River drainage. The loadings are in pounds per square feet.

Snowfall in the Bridger Bowl ski area offers an average of 120 skier days over a six month period, roughly November through April. From 1961 through 1985, the snow water equivalent at Bridger Bowl averages 28.7 inches.(5) Above 7,000 feet elevation, snow melts at a considerably lesser rate during the winter season. This will create related problems for snow removal above this elevation.

The valley floor has a shorter and more irregular interval of snowfall. Development in higher elevations should consider clustering in order to minimize snow removal. Grades or access roads to areas contemplated for development should follow guidelines described in the Gallatin County Road Standards.

Recommendations: Certain areas in Bridger Canyon may pose severe restrictions for development due to localized climatic conditions. Snow build-up and drifting will be a potential problem in areas receiving long shade cover. This indicates that the sunnier slopes away from the winter winds are the optimum comfort locations.

TEMPERATURE: The most striking feature of the temperature range in Bridger Canyon is the relative mildness of the extreme reaches. A common thought is that Northern locations have cold climates. In reality, unqualified figures show the winter temperatures to rarely go below -10 degrees Fahrenheit, and to average in the 70 degrees Fahrenheit in the summer. Diurnal temperatures vary 30 degrees Fahrenheit. Few summer days have temperatures over 85 degrees Fahrenheit, and winter evening temperatures often are as cold as 10-20 degrees Fahrenheit. Winter temperatures in the canyon tend to run five to ten degrees greater than those recorded in Bozeman.

WINDS: There are two general wind patterns operating within the canyon area. The Northern reaches of the canyon experience prevailing winds in North and South, Southwest directions. From Jackson Creek Road South, prevailing winds are from the Southwest and occasionally from the East.

Gentle breezes generally occur during summer evenings. High winds are most apt to occur during the Winter months, with gusts sometimes reaching 90 miles per hour.

Fall is considered the most delightful time of the year by many residents. Nights are brisk and days bright and warm, often into November and even December. Spring, particularly April and May, experiences a stormy struggle between Winter and Summer. Cloud cover varies annually. Residents of the canyon estimate roughly two-thirds of the year result in cloudless or semi-cloudy skies. Fog conditions are rare in Bridger Canyon.(6)

WATER RESOURCES

GENERAL PROVISIONS: The common objective of the Bridger Canyon landowners is to promote the conservation, development, and beneficial use of the canyon's water resources.

The Montana Department of Natural Resources and Conservation (DNRC) will coordinate the development and use of the water resources of Bridger Canyon so as to effect full utilization, conservation, and protection of its water resources.

The development and utilization of water resources and the efficient economic distribution within Bridger Canyon focuses on protecting existing uses and to assure adequate future supplies for agricultural, domestic, recreation, wildlife, and other beneficial uses.

Any attempt to gain control of or speculate on large quantities of ground water is not in the interest of the people and is to be restricted.

WATER RIGHTS: Every person asserting a claim to an existing right to the use of water is required to file a statement of claim to that right on a form provided by the Department of Natural Resources and Conservation (DNRC).

The DNRC shall file a copy of each statement of claim with the Clerk of District Court of Gallatin County in which the use occurs.

The failure to file a claim of an existing right establishes a conclusive presumption of abandonment of that right.

Bridger Canyon is not part of a controlled groundwater sub-area. Therefore, a permit is not required before appropriating groundwater by means of a well or developed spring with a maximum appropriation of less than one hundred (100) gallons per minute. Within sixty (60) days of completion of a well or developed spring and appropriation of the ground water for beneficial use, the appropriator shall file a notice of completion with the DNRC on a form provided by the department at its offices and at the office of the Gallatin County Clerk and Recorder.

Additional information in reference to water appropriations, adjudications, and limitations for Bridger Canyon can be obtained from the Department of Natural Resources and Conservation Field Office, Bozeman, Montana.

SURFACE WATER RESOURCES: Bridger Canyon has a complex drainage system characteristic of mountainous topography. The primary streams making up the system are Bridger Creek and Jackson Creek. All the drainage from the canyon is received by the Gallatin River.

Bridger and Jackson Creeks provide seasonal services of water for agricultural and domestic needs. The average annual water budget for the Bridger Creek Watershed is 100,000 acre feet. Since 24,000 acre feet flow out of the canyon annually, it is assumed that the balance is expended through evaporation, transpiration, and subsurface flows. (Source: Montana Snow Survey, U.S. Department

of Agriculture, Soil Conservation Service). The streams in the canyon are ideal habitat for fish and wildlife, and attractive for recreational users.

Recommendations: With growing suburban development in the canyon, competition may arise among home owners and ranchers over available water supplies. If the agricultural character of the valley is to be retained, restrictions must be placed on the location and density of development.

GROUND WATER RESOURCES: Ground water is the major source of supply in the Bridger Canyon. At the present time, it is being used for both agricultural and domestic uses. There are currently four (4) water supply systems in the canyon. They are located near and/or associated with the Bridger Bowl Ski area. Privately owned wells or springs provide residents with their water needs. Ground water appropriations for the Bridger Canyon area are on record with the DNRC.

Bridger Canyon lies within the Gallatin Valley Drainage Basin as defined by the U.S. Geological Survey. The aquifer borders the Gallatin River and its major tributaries. The following general information typifies the water resources: (7)

Precipitation.....	annual average 18 inches
Well depths.....	10-250 feet
Water table.....	2-25 feet
Well yields.....	5-200 gpm
Temperature of well water.....	44-59 degree Fahrenheit

Recommendations: Due to the complicated geologic structure in the canyon, it is highly advised that home builders first drill a well prior location for their water well prior to construction.

WATER QUALITY: An appreciative attraction to the Bridger Canyon area is the surface streams. They are clear, cold, and relatively free of pollution. This high level of water quality experienced within Bridger Canyon is attributable to pristine source conditions, light population densities, and moderate intensity of land use activity. Changes in any of these conditions poses the potential for degradation of water quality. Projected population increases, combined with the associated increases in land use activity, indicate that without some control measures the water quality level within the area may be expected to decline in future years.

Investigations performed by the State Water Quality Bureau give an accurate picture of the current water quality. (See Appendix F, -Water Quality- for detailed information). Phosphates and nitrates were measured because high concentrations of these chemicals leads to production of algae. Chlorides were tested because they are an indicator of man's activities. Turbidity readings were made to indicate erosion effects in the watershed. Coliform tests were taken to determine whether or not bacteria from untreated sewage, harmful to man, was present in surface waters.

NON-POINT WATER SOURCE ASSESSMENT SUMMARY: Non-point sources in the planning area are grouped under the following:

1. Agriculture
2. Silviculture

3. Mining
4. Construction
5. Groundwater
6. Hydrologic Modifications

AGRICULTURE: Erosion and sedimentation from cultivation, livestock concentrations, and stream bank management are the main sources of sediment loads from agricultural operation in the area. Confined livestock operations at certain points are contributing nutrients and fecal contamination to state waters. Irrigation return flows are not believed to be a significant water quality problem.

SILVICULTURE: Timber harvesting in easily erodible and unstable geologic formations has increased sediment loads from certain drainages in Bridger Canyon. Past management activities will likely continue to create problems for a number of years in the future.

MINING: No past or present mining operations in the area are currently affecting water quality.

CONSTRUCTION: Building and road construction sites in Bridger Canyon are contributing sediment to streams.

GROUNDWATER: Slight increases of total dissolved solids in groundwater over the past twenty five (25) years are believed attributable to increased leaching of dissolved solids resulting from increased use of irrigation water. The increases are believed to be of only academic interest at this time. Continued monitoring is recommended on a ten (10) year interval.

HYDRAULIC MODIFICATION: Channel straightening, modifications by landowners, and constructions caused by bridges and other construction, have significantly increased sediment loads.

POINT WATER SOURCE ASSESSMENT SUMMARY: Point sources identified in Bridger Canyon can be grouped into the following two (2) categories:

1. Animal confinement facilities
2. Fish hatcheries

The owner or operator of any point source discharging pollutants into state waters must comply with the following permit application requirements:

1. Have filed a complete Refuse Act permit application with the U.S. Army Corps of Engineers which satisfies the filing requirements for NPDES (National Pollutant Discharge Elimination System); or,
2. Have filed a complete NPDES permit application with EPA; or,
3. File an MPDES (Montana Pollutant Discharge Elimination System) permit no less than 180 days prior to the day on which it is desired to commence operation of the point source. (Section 402(b) of the Clean Water Act allows for the transfer of jurisdiction of NPDES in

Montana from the U.S. Environmental Protection Agency to the State of Montana, Department of Health and Environmental Sciences).

The only discharge permit to date in Bridger Canyon is the U.S. Fish Cultural Development Center located on Bridger Creek.

WATER QUALITY STANDARDS: The State of Montana has established water quality standards in accordance with the Clean Water Act. These state standards became effective in 1965. The State periodically reviews and updates these standards. Enforcement responsibilities are assigned to the Water Quality Bureau of the Department of Health and Environmental Sciences. Each stream segment in the state is assigned a classification which establishes the water quality standards to be maintained.

All stream segments in Bridger Canyon are currently classified B-1, which is a higher water quality than waters classified B-2. Waters classified B-2 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

For waters classified B-1 the following specific water quality standards shall not be violated by any person:

1. During periods when the daily maximum water temperature is greater than 60 degree Fahrenheit, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10 percent of the total samples during any 30 day period to exceed 400 fecal coliforms per 100 milliliters.
2. Dissolved oxygen concentration must not be reduced below 7.0 milligrams per liter.
3. Indexed variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.
4. The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 16.20.633.
5. A 1 degree Fahrenheit maximum increase above naturally occurring water temperature is allowed within the range of 32 degrees Fahrenheit to 66 degree Fahrenheit, no discharge is allowed which will cause the water temperature to exceed 67 degrees Fahrenheit; and where the naturally occurring water temperature is 66.5 degrees Fahrenheit or greater, the maximum allowable increase in water temperature is 0.5 degrees Fahrenheit. A 2 degree Fahrenheit per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55 degree Fahrenheit and a 2 degree Fahrenheit maximum decrease below naturally occurring water temperature is allowed within the range of 55 degree Fahrenheit and 32 degrees Fahrenheit.

6. No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

7. True color must not be increased more than five (5) units above naturally occurring color.

8. Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 143) or subsequent revisions. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bioassay or other methods. The values listed in the EPA Water Quality Criteria documents (Federal Register Vol 45, No. 231, Friday, November 28, 1980, pages 79318-79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with Section 75-5-306 (1), M.C.A., it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water. (8)

Recommendations: As Bridger Creek is a major source of the attraction to the canyon, policies and regulations will have to be established for development which will protect its water quality. Water for urban uses must not be appropriated from areas which would thereby threaten the agricultural base of the valley.

WATER MANAGEMENT PRACTICE: Management plans encompassing control measures for protection of water quality are being developed nationwide and the term "Best Management Practices" (BMP) has been coined to describe the identification of management practices which if utilized will minimize the impacts of sources of water pollution. The information contained in Appendix F outlines BMP's for selected land uses in the Bridger Canyon.

LAND RESOURCES

VISUAL RESOURCES: Bridger Canyon's natural appearance is a model example of the diversity of physical and living features found in the Rocky Mountains of the Western United States. The canyon is endowed with jagged mountains, rolling foothills, riparian bottomlands, coniferous forests, native grasslands and a host of wildlife. The visual qualities must continually be maintained in order to preserve the canyon's indigenous character and quality of life.

FOREST LANDS: Forested areas in Bridger Canyon are shown on the timber croplands map. Commercially saleable timber crops largely consist of Lodgepole Pine and Douglas Fir, which are outlined on the map. Poorly stocked stands of timber are shown by a separate symbol.

A substantial amount of land within the Bridger Canyon jurisdictional area is managed by the Gallatin National Forest, and is included in the Gallatin Forest Plan and Management Area Map. Each management area has a multiple use prescription which consists of goals, management practices, standards and guidelines for that area. According to the plan, only a small portion of National Forest Land in Bridger Canyon is suitable for timber production. Additional information pertaining to ownership adjustments, access and easements, non-recreating special use grants, road and trails, and other standards and guidelines can be found in the Gallatin Forest Plan. The Gallatin Forest Plan and Management Area Map can be obtained from the U.S.D.A., Forest Service, Gallatin National Forest, Federal Building, Bozeman MT 59715.

Recommendations: Non-erosive harvesting methods must be practiced to keep damage to a minimum.

Locate homes in break in forest cover to avoid fire danger.

Reclamation practices should include: erosion control measures; re-vegetation with native grasses, mixed stands of Douglas fir, Lodgepole pine and spruce; slope retention; and road maintenance.

Access to commercial and non-commercial timbered areas for fire protection, recreation, and commercial hauling should be maintained so this resource can be properly protected and managed.

All properties in Bridger Canyon must be properly managed under Forest Management Plan coordinated by the Gallatin National Forest, the Department of State Lands and other timber landholders. With special regulations and logging practices, timber can be removed without disruption of the natural beauty and environment of the valley.

It is strongly recommended that any logging activity on private land be coordinated through the Bridger Canyon Property Owners Association, the Gallatin National Forest, and the Department of State Lands.

SUGGESTED LOGGING STANDARDS: Advisory suggestions dealing with logging practices in timber croplands are as follows. The following text is a summary of suggested standards for logging operations on private land:

1. Locations for any new roads will be approved by appropriate authority prior to construction. On completion of logging, all roads that the property owner desires to use will be turned over to him for future maintenance. Roads not desired for future use shall be obliterated as well as possible.
2. General cutting will be limited, by the appropriate authority in areas along live streams and those meadows and parks visible from the main valley.
3. General logging recommendations:
 - a. Landing locations will utilize natural openings and will be returned to as near before condition as possible.
 - b. Piling or burning of logging debris shall be done pursuant to health and fire safety laws.
 - c. Stump heights will be kept to a minimum and not to exceed 12".
 - d. All skid crossings will be smoothed and returned to as near before condition as possible.
 - e. Generally, logging equipment will not be allowed nearby to live stream beds.
 - f. Generally, the minimum spacing between logging roads shall be 400'.

Listed in Appendix H are additional guidelines available for private landowners for adopting and implementing the best management practices for forestry in Montana. These guidelines were created by the U.S. Forest Service and the Montana Department of State Lands.

The Montana Department of State Lands provides forestry services to private forest owners and the wood products industry. For additional assistance or information concerning forest management, contact the Bozeman Unit Office, P.O. Box 1343, 25 East Mendenhall, Bozeman, MT 59715.

WEED CONTROL: Bridger Canyon hosts a variety of noxious weeds. These weeds poison vegetation which in turn leads to the loss of wildlife habitat, increased soil erosion, and lower property values.

Successful control of noxious weeds in Bridger Canyon requires cooperation between private landowners, public land users and governmental agencies. Recommended control measures include the following:

1. Avoid driving motorized vehicles across noxious weed infested areas.
2. Do not purchase or transport hay or grain contaminated with noxious weeds.

3. Minimize soil disturbance on range and other non-crop land.
4. Use herbicides to eliminate small patches of noxious weeds.
5. Seed desirable perennial species immediately on all areas that have been disturbed by construction, mining or other activities.
6. Obey the weed laws and support local weed control programs.

Gallatin County has established a weed control district according to Montana law. The purpose of the district is to enforce all pertinent Montana Noxious Weed Control Laws and to manage all noxious weeds according to those laws. Programs offered by Gallatin County include herbicide cost sharing, sprayer rentals and noxious weed mapping and plan developments. For information on weed control write: Gallatin County Weed Control District, Room 304, Courthouse, Bozeman MT 59715.

MINERAL EXTRACTIONS: Historically, only a limited amount of surface excavations in Bridger Canyon have taken place. Those operations have been gravel pits, used primarily for private purposes.

The Bridger Canyon/Kelly Canyon area lies in the energy rich overthrust belt of the Northern Rocky Mountain region. In recent years, oil and gas leasing activity in the canyon has increased significantly. Sohio and American Quasar Petroleum Companies have conducted active seismic exploration and have identified a geologic structure believed to contain oil and gas. In March of 1986, Sohio Company drilled an exploratory well located on lands owned by Mr. and Mrs. Lloyd Moats. At depths reaching 15,000 feet, no oil or natural gas was found. According to Sohio, about one (1) exploratory, or "Wildcat" well out of every twenty (5%) will produce commercially marketable petroleum.

Mineral rights on privately owned land in Bridger Canyon go with the property, provided that there are no prior mineral right reservations or patents on the property. The Bureau of Land Management has on file any prior mineral right reservations or patents on all private lands in Montana. This information is also on file with land title companies. The BLM can be contacted at: Montana State Office, Bureau of Land Management, 222 North 32nd Street, PO Box 36800, Billings MT 59107.

Under the provisions outlined according to Montana Law, mining activities in the Bridger Canyon Zoning District can be regulated by the Zoning commission. As described in the Bridger Canyon Zoning Regulation, gravel, coal, minerals, and oil and gas exploration or drilling in the area are considered a conditional use, and must comply with state regulations and conditional use permit stipulations.

Any oil and gas activities in Bridger Canyon must meet state regulations pertaining to oil and gas exploration, development, and production. The regulations are found in the "General Rules and Regulations Relating to Oil and Gas," Board of Oil and Gas Conservation, Montana Department of Natural Resources and Conservation, 25 South Ewing, Helena MT 59620.

FISH AND WILDLIFE: A natural phenomenon of the Rocky Mountains is the numerous species of wildlife. Mule deer, whitetail deer, bear, elk, moose, mountain goats, and even mountain lions are found in Bridger Canyon along with various small animals.

The Wildlife Ranges Map outlines the general location of winter and summer ranges for deer, elk, and mountain goat. Deer and elk seek lower elevations for winter survival. If these species are to continue to survive in the canyon, trees, brush cover, and grasses, along with animal trails must be retained in both winter and summer range areas.

Bridger Canyon is home to a wide variety of bird species. Water fowl are dependent upon the canyon's wetlands while upland game birds are found almost everywhere. Waterfowl species include geese, blue heron, and a variety of ducks. Upland game species include grouse, pheasant, and partridge. Eagles, hawk and owl species are the canyons's birds of prey.

Bird survival is sensitive to environmental changes. Destruction of both wetland and dryland vegetation could severely reduce habitat for all species in Bridger Canyon.

Trout species are found in Bridger and Jackson Creeks and their tributaries. Trout survival is entirely dependent on the water quality of the streams. High quality fishery maintenance will be subject to erosion and pollution controls implemented by canyon residents.

Recommendations: Retain animal habitat in winter and summer.

Bear-proof garbage facilities.

Maintain wetland and dryland vegetation for game birds.

Minimize fencing whenever possible.

Minimize construction around and near streams.

CULTURAL RESOURCES

EXISTING LAND USES: Scattered rural development and agriculture are the two primary land uses in Bridger Canyon. Agriculture dominates as an existing use in the lower elevations of the canyon. Agricultural uses presently being practiced in the planning area include irrigated and dryland hay production, livestock raising, and tree farming.

Residential structures are found in a widely dispersed pattern of single locations throughout the canyon, and are generally spread out along the main roads.

Currently commercial ventures in Bridger Canyon are located at Crosscut Guest Ranch, the Silver Forest Bed and Breakfast establishment, the Flaming Arrow Lodge Special Events Center, and the base facilities at the Bridger Bowl Ski area. There are no existing industrial land uses in the canyon.

There is land allotted for public facilities lying within the planning area. Under provisions outlined in the Zoning Regulation, public facilities, i.e., fire and police stations, municipal buildings, parks, etc., are allowed as a matter of right. As of this date, Malmborg Elementary is the only school in the planning area; all other students are bussed to schools in Bozeman. Bridger Canyon has its own fire protection facility and community center.

Land use maps for the Bridger Canyon Zoning District are provided in Appendix I. The maps show all state and county roads, land subdivision, subdivision roads, residences and public facility structures. All remaining land uses in the canyon are either hay fields or pasture. Land uses in the higher elevations of the canyons are predominantly forest related.

LAND OWNERSHIP: The land ownership map shown in Appendix J, displays the large property holdings in the Bridger Canyon planning area. These ownerships and their boundaries have slight relationship to natural features such as streams, ridges, slopes and meadows.

EXISTING ZONING: The Bridger Canyon Zoning Regulation was officially adopted in October of 1971, and has been amended on a periodic basis. The intent of the Zoning Regulation is to regulate and promote orderly development of the area. Agricultural preservation is a primary goal which is to be accomplished by limiting development to one (1) dwelling unit per 40 acres or one (1) dwelling unit per twenty (20) or ten (10) acres with a planned unit development except as provided in the Bridger Bowl Base Area. The forty (40) acre minimum lot size, except as allowed through a planned unit development, is based on limiting population so that the capacity of the two (2) lane highway is not exceeded. Prior to the adoption of the Zoning Regulation, development was concentrated in parcels less than 20 acres. The Bridger Canyon Property Owners Association continues to monitor and support regulations that institute proper conservation measures and orderly growth.

In 1979 the Bridger Bowl Base Area Conceptual Plan was adopted. In October of 1985 the Bridger Bowl Base Area Plan ("Base Area Plan") was updated and adopted. In 1989 the Base Area Plan and Zoning Regulation were amended to allow for both recreational housing and overnight accommodations in the Bridger Bowl Base Area ("Base Area"). Recreational housing is defined as

housing which does not have restriction on length of stay and includes attached and detached single family units. When the Zoning District was created single family dwelling units were allowed in the Base Area through the Recreation and Forestry (RF) District designation attached to the Base Area. In the Base Area Plan and Zoning Regulation the development rights were allocated to the property in the Base Area. Generally, twenty-five percent (25%) were allocated to recreational housing the seventy-five percent (75%) were allocated to overnight accommodations. The Base Area Plan is a site specific plan for the Base Area and is adopted as part of this General Plan and Development Guide and by this reference is incorporated herein.

Originally, the Base Area consisted of approximately 400 acres. When the General Plan and Development Guide and the Bridger Canyon Zoning Regulation were adopted a development right of two (2) dwelling units per acre (approximately 800 dwelling units) with a planned unit development was established for the Base Area. In 1989 200 development rights for recreational housing (25%) and 600 development rights for overnight accommodations (75%) were allocated to the property in the Base Area.

In 1990 the Base Area was expanded with the addition of the 100 acre North Base Area. As a condition of that approval the total number of Base Area development rights did not change and a covenant was placed on the 100 acre parcel requiring any development proposal to include a second ski base. In 1991 a second addition to the Base Area was approved for a 260 acre parcel located at the northeast corner of the Base Area and commonly referred to as the Hammersmark property. As a condition of that approval the total number of Base Area development rights did not change, that a single planned unit development proposal was required for all properties owned by the applicant, that the development of the property was limited to 70 units which must be served by the Base Area central sewer and water systems and that residential structures on the property must be set back 400 feet from Bridger Canyon Road.

The condition that the 260 acre parcel, commonly referred to as the Hammarsmark property, be served by the Base Area central and community water system was eliminated following public hearings before the Planning and Zoning Commission and Gallatin County Commission. (Amended: County Commission Resolution No. 1995-52).

With these expansions of property the Base Area consists of approximately 760 acres with approximately 800 development rights as set forth and allocated in the Base Area Plan and Zoning Regulation. (Amended: County Commission Resolution No. 1995-25).

In 1996 the expansions of the 1990, 100 ± acre North Base Area and the 1991, 260 ± acre Hammarsmark property were de-annexed from the Base Area. The Base Area development rights remain the same as the 1989 development right allocation. This allocation allows 200 development rights for recreational housing (25%) and 600 development rights for overnight accommodations (75%). (Amended: County Commission Resolution No. 1996-4).

DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

POPULATION GROWTH: Gallatin County and the City of Bozeman are growing at a rate faster than either the State of Montana or the United States. While Montana grew 13.4 percent in the ten-year period from 1970-1980, Gallatin County increased 31.9 percent and Bozeman increased 15.9 percent. The following table displays Montana, Gallatin County, and Bozeman's population growth from 1960 through 1980.

	<u>YEAR</u>			<u>PERCENT CHANGE</u>	
	<u>1960</u>	<u>1970</u>	<u>1980</u>	<u>1960-1970</u>	<u>1970-1980</u>
MONTANA	675,000	690,000	786,690	2.80%	13.35%
GALLATIN COUNTY	26,045	32,505	42,865	24.80%	31.90%
BOZEMAN	13,361	18,670	21,645	39.70%	15.93%

Based on past trends and current development, the population of Bozeman and Gallatin County is expected to increase at a 2.0% annual growth rate. Growth should be evenly distributed through the year 2000. If a major boost in the economy occurs and a major industry locates in Bozeman, an upswing in population could occur adding to increased land development in Bridger Canyon. The following table displays population projections for Gallatin County and Bozeman from 1985 through 2000.(9)

	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
GALLATIN COUNTY	47,151	53,045	59,676	67,135
BOZEMAN	23,809	26,190	29,333	32,853

In 1971, the population of the Bridger Canyon planning area was approximately 300 persons. For the most accurate determination of population growth in the area, a land use permit analysis was conducted which tabulates the number of dwelling units and population added each year since 1972. (10)

YEAR	NEW DWELLING UNITS	ADDED POPULATION (11)
1972	8	20
1973	10	25
1974	8	20
1975	8	20
1976	8	20
1977	12	30
1978	18	45
1979	15	37.5
1980	6	15
1981	7	17.5
1982	5	12.5
1983	4	10
1984	5	12.5
1985	6	15
1986	5	12.5
1987	4	10
TOTAL:	129	327.5

Since 1971, 129 single family dwelling units have been constructed in Bridger Canyon, adding approximately 327 new residents to the planning area. The present population of the area is estimated at 600 people.

Estimations for future growth in Bridger Canyon can be most accurately based on the average number of new dwelling units during the previous five (5) years. By referring to the previous table, an average of five (5) dwelling units and twelve (12) residents per year are added to the Bridger Canyon Planning area.

The following table shows the estimated population of Bridger Canyon through the year 2000.

YEAR	POPULATION
1987	600
1990	637
1995	699
2000	761

POPULATION DENSITIES: Permanent housing in those areas of the Bridger Canyon Zoning District outside the Base Area is limited to one (1) dwelling unit per 10, 20 or 40 acres depending upon criteria set in the Zoning Regulation. Permanent housing in the Base Area is limited to a maximum number of recreational houses in accordance with the density set forth in the Base Area

Plan and the Base Area Planned Unit Development Section of the Zoning Regulation. (Amended: County Commission Resolution No. 1995-25).

Recreational accommodation densities are as follows:

- a. Ski base: up to an average of eight (8) persons per acre;
- b. Guest Ranches: up to an average of one (1) person per acre, (excluding ski base area) depending upon the amount of on-site facilities to minimize off-site impacts and depending upon requirements set forth in the General Plan. Maximum accommodations for Bridger Bowl and guest ranches at one thousand (1,000) persons;
- c. Campsites: up to twelve (12) persons per acre. The maximum number of campsites shall not exceed 250.

ECONOMIC CONSTITUENTS: Income from agricultural practices in Bridger Canyon is limited. Most landowners can only maintain their land in agricultural production with the help of outside incomes. No change in this situation is expected in the foreseeable future. The agricultural uses which create open spaces and contribute to the appearance of the canyon are in jeopardy.

Recommendations: Determine methods to keep a healthy agricultural and residential atmosphere in Bridger Canyon.

Encourage cluster developments, preserving open space.

Strictly enforce the Zoning Regulation to ensure land subdivision in conformity with the General Plan.

RESIDENTIAL AND COMMERCIAL DEVELOPMENT

RESIDENTIAL: To reach the goals of maximizing the attractiveness of the developed areas and preserving the farm-ranch rural atmosphere, residential development must be planned with care and creativity. Generally, the residential areas in those areas of the Bridger Canyon Zoning District outside the Base Area are expected to accommodate one (1) dwelling unit per forty (40) acres or one dwelling unit per twenty (20) acres or ten (10) acres with a planned unit development. The residential areas in the Base Area are expected to accommodate a combination of recreational housing and overnight accommodations. In the Base Area the residential areas are expected to accommodate approximately 200 recreational housing units and 600 overnight accommodation units. The specific information pertaining to residential densities are located in the Zoning Regulation and the Base Area Plan. The ski area is expected to accommodate 3,000 visitors in overnight accommodations and recreational housing within the Base Area. Here, multiple clustered housing which does not impair scenic values is essential to accommodate the increasing number of seasonal and permanent residents. (Amended: County Commission Resolution 1995-25). (Base Area owner density rights amended by Resolution 1999-1 on January 26, 1999.)

While vast areas of public land in Bridger Canyon are best preserved by remaining relatively undeveloped, more intensive use of the buildable forested areas is encouraged. It is proposed that

the residential areas be developed in such a way as not to interfere with the open meadows, and well away from the wetland areas along the stream beds. Public use for recreational activities should be permitted on public lands, but only on a planned basis.

In the allocation of land areas for residential development, basic concepts were formulated to indicate preferences in the use of each land allotment. The following concepts are all based on the premise of maintaining the existing canyon character as much as possible:

CONCEPT A: PRIME BUILDING SITES

These sites, considered to be best for residential development, are based on:

1. Adequate vegetative (tree) cover and/or sufficient local topographic relief to screen or soften visual impacts of development.
2. Slope and soil stability.

A cluster design is possible and encouraged here.

CONCEPT B: SECONDARY BUILDING SITES

These sites are considered to be next best for residential development and are based on:

1. Lower topographic slope conditions - not to exceed 20% slope and/or limited vegetative (tree) cover to soften development.
2. Slope and soil stability.

CONCEPT C: TERTIARY BUILDING SITES

These sites are considered to be best for low density development due to:

1. Lack of vegetative (tree) cover and lack of sufficient local topographic relief to visually screen or soften development.
2. And/or unstable slope and soil conditions.

These sites are considered to be the most suitable for single family residential development.

CONCEPT D: WETLANDS

These sites deserve special treatment due to their sensitive qualities.

1. Only low density residential development will be allowed, no more than one (1) unit per 40 acres.

2. Allow no dense build-up of buildings in any one (1) place, prefer no cluster developments.
3. In all cases, the streamside vegetation should be left undisturbed.

It is not the intention of the preceding concepts to permit development only in acceptable areas. They are merely designated as those areas most able to handle development, under the parameters set forth. They are meant to be used as a guide in locating buildings within the canyon. Prime and secondary buildable sites along with wetlands are outlined in the context of a development guide.

RESIDENTIAL DEVELOPMENT CRITERIA:

1. Non-clustered development of 40 acre and larger homesites will occur as a "matter of right" pursuant to locations set out in the Zoning Regulation for this use. If permitted by terrain, a minimum setback of 200 feet should be observed from Bridger Canyon, Jackson Creek, and Kelly Canyon roads for the homesite itself. Homeowners are urged to maximize distances of structures from roads. Thus the agricultural character of the valley will be emphasized and the visual influence of having structures diminished.
2. Clustered development of homesites should occur under development standards requiring the preparation of specific plans for review by the Bridger Canyon Planning Zoning Commission. Design criteria for such development should include:
 - a. retention and management of open space,
 - b. development of on-site recreational facilities,
 - c. separation of automobile and pedestrian-equestrian travel on the site,
 - d. limited access to Bridger Canyon, Kelly Canyon, and Jackson Creek roads,
 - e. parking areas or other large paved areas to be fringed with natural or man-made landscaping,
 - f. building clusters to be hidden from view to motorists on the canyon's arterial roads by:
 - (1) natural vegetation,
 - (2) landscaping,
 - (3) terrain, or,
 - (4) a setback of at least 500 feet from such roads.
 - g. erosion control measures for building, road, parking lot and recreational facilities,
 - h. fire suppression and control,
 - i. installation and management of water and sewage facilities,
 - j. underground locations for power and telephone service,
 - k. studies of surface geology and soils to indicate problems and their solutions relating to development,
 - l. solid waste disposal plan.

NEIGHBORHOOD COMMERCIAL FACILITIES: Other than the Bridger Bowl Base Area facilities, it is highly improbable that there will be sufficient trading activity in the canyon to warrant much in the way of commercial establishments. At most, one centrally located, five (5) acre maximum neighborhood facility is anticipated. This development would provide for servicing daily living needs.

What is considered to be an optimum site for this facility is located at the intersection of Bridger Canyon and Jackson Creek roads. The location is shown on the General Map Plan.

COMMERCIAL DEVELOPMENT CRITERIA:

1. Neighborhood commercial facilities: Not more than five (5) acres of this type of use are required to serve the needs of the residents at full development. Basically, the same criteria as proposed for cluster residences will apply in the case of neighborhood commercial facilities. They are:
 - a. Select an architectural style and building materials compatible to the canyon;
 - b. Make provisions for landscaping, erosion control, weed control, fire protection, safe sewer and water operation;
 - c. access limitations based on safety to travelers on the main roads;
 - d. Underground power and telephone services;
 - e. Signs to be restricted in size, with flashing or oscillating signs prohibited. Signs shall only be lighted from the exterior.
2. Ski Base Facilities, including commercial outlets: Since the ski base concentrates activities at the top of the canyon's watershed, its design and construction is critical to all residents in the lower canyon. Development criteria should include:
 - a. Adherence to Base Area Plan densities and day use parking limitations;
 - b. Strict limitations on treatment and disposal of sewage effluent.
 - c. Hide buildings from view of motorists on Bridger Canyon Road by retention of natural vegetation or installation of landscaping;
 - d. Preparation of and adherence to erosion control plans for all construction including : ski slopes, commercial and residential buildings, roads, parking lots, service and recreational areas, based on soils and geology studies;
 - e. Underground power and telephone service;
 - f. Re-vegetation and weed control of areas which are now or may in the future become denuded due to construction activities;
 - g. Selection of architectural styles and materials compatible with the natural landscape;
 - h. Building designs which take into account snow loads of up to 200 pounds per square foot;
 - i. Fire control measures for structures and escape routes for residents;
 - j. Separation of pedestrian and vehicular movements within the base area insofar as possible;
 - k. Solid waste disposal plan;
 - l. Sign control (i.e., limit sizes and prohibit flashing or interior lighted signs).

CIRCULATION SYSTEM: The General Plan calls for no basic changes in the existing road network in the canyon. Bridger Canyon, Jackson Creek, and Kelly Canyon Roads are the only arterial roadways. These three (3) roads will act as a circulation spine servicing all the necessary secondary, or subdivision roads to residential developments. No additional arterial to the canyon will be constructed or designed.

A trail system has been suggested the General Plan to link most existing and proposed recreational development. This trail system would provide for safe pedestrian-equestrian movement with ties to trails beyond the canyon. Future plans would like to provide for an extended right-of-way- along Bridger Canyon road to serve the needs for recreationalists, i.e., joggers, hikers and bicycle riders.

VACANT HOMESITE ASSESSMENT: In February, 1989, there were seventeen (17) platted subdivisions in the Bridger Canyon Planning Area. The lot sizes range from less than five (5) acres to greater than 40 acre tracts. Many of the lots that are less than 20 acres were created prior to the 1971 Zoning Regulation.

In February, 1989, data compiled from field reconnaissance and building permit analysis shows that there are currently nine (9) vacant homesites less than five (5) acres, 80 vacant homesites in the 5 to 20 acre range, and 39 vacant homesites being greater than 20 acres in size. The majority of those homesites in the later group are 40 acre tracts. (Amended: County Commission Resolution No. 1995-25).

RECREATION

RECREATION ASSESSMENT: The offering of recreational activities within Bridger Canyon is highly diversified to include: fishing, hunting, camping, picnicking, trail hiking, horseback riding, bicycling, snowmobiling, and alpine and cross-country skiing.

It is an underlying objective of the canyon residents to support the establishment of recreational uses in harmony with the natural setting, while insisting upon limitations to prevent damaging environmental effects. These limits are designed to prevent any significant change in the environmental character of the canyon. Access control provides the basic limiting element. Any increase in traffic movements, resulting in the need for a four-lane roadway, would be considered a major detriment to the canyon. All proposed development should be reviewed in terms of: its sensitivity to surrounding uses; its influence on water quality; its access and traffic generation potential; and its overall effects on the environmental quality.

There are two major recreational elements included in the plan: the trail system and the ski base area. The trail system, as mentioned earlier under the circulation system, has been designed to act as a linking element among all the various recreational activities offered. It will link together both the recreational uses on private land and in the public National Forest lands.

The Bridger Bowl ski facility acts as a major attraction to the Canyon for winter sport activity. A separate Base Area Plan has been adopted to promote the careful development and construction of the ski base. As a major attraction feature, Bridger Bowl will impose important effects upon the environmental quality of the canyon. To set a controlling element on those effects, a limit is placed on the number of planned parking spaces and over-night facilities.

The Bridger Bowl ski facility can presently handle 3,500 skiers per day. The Bridger Bowl Ski Association estimates an expansion potential of 8,000 day users. There is presently a 1,000 car parking facility with an additional 520 planned expansion. With an average of three persons per car, this allows for 4,500 day users. An additional 3,000 persons will need to be provided for in base operations and over-night facilities. This gives a total planned figure of 7,500 persons.

It is felt that this figure can be adequately accommodated on the present two-lane road, with upgrading improvements. The 3,500 skiers per day figure could be increased to the full recommended potential and still maintain a two-lane roadway by expanding bussing services from hotel and motels, expansion of ski base accommodations, limit the size of the automobile parking lot, and promoting night skiing to lessen the peak hourly flow of traffic.

RECREATIONAL STANDARDS:

1. Plans for campgrounds and picnic areas should include:
 - a. Potable water supply;
 - b. Suitable methods for disposal of wastes in accordance with State and County standards;

- c. Fire breaks and fire safety planning along with stove design and campfire regulations are to be in accordance with U.S. Forest Service requirements;
 - d. Dust control measures;
 - e. Erosion and weed control for all areas where the natural vegetation has been removed;
 - f. Bear-proof garbage containers;
 - g. Supervision and maintenance.
2. Plans for snowmobiles and cross-country skiing:
- a. Location of trails in open areas, away from residential areas;
 - b. No snowmobile trails near the Bridger Bowl base area;
 - c. Off-road parking for autos and trailers;
 - d. Sanitary facilities for participants and adherence to sanitary requirements.

UTILITIES, TRANSPORTATION AND WASTE DISPOSAL

UTILITIES: There is presently one central sewer/water utility systems in operation within the planning area, which serves the Bridger Pines Subdivision. Individual homes are serviced by private, localized water wells and septic systems. Electrical power is provided by the Montana Power Company of Bozeman. While main supply lines run overhead, it is highly recommended that secondary power lines servicing homesites and commercial facilities be installed underground. This would help to preserve the natural landscape of the canyon.

TRAFFIC GENERATION: Count information was supplied by the Montana Department of Highways for the years 1983 through 1985.

The following table shows figures for average daily traffic along Bridger Canyon Road, State Highway 86. Traffic counts were conducted at two stations located at the entrance to Bridger Canyon west of the Fish Hatchery and at the north end of the planning area, near Bridger Bowl.

AVERAGE DAILY TRAFFIC

	1983	1984	1985
Bridger Canyon Road West of the Fish Hatchery	1,409	1,436	1,443
Bridger Canyon Road North of Planning Area	890	710	700

In summary, traffic counts at the south entrance of the Bridger Canyon Planning Area have increased only slightly over the past few years. Traffic counts at the north entrance show a slight decrease over time.

Future average daily traffic on Bridger Canyon Road will continue to grow at a slow rate. This increase will be dependent upon additional residents to the area and increased skier days at Bridger Bowl.

During the winter season, the Bridger Bowl ski facility creates a peak traffic count of approximately 1,200 vehicles per hour from 3:00 to 5:00 p.m. Peak hourly traffic on Bridger Canyon Road will continue to be attributed to the ski area and could reach volumes as high as 1,500 vehicles per hour, unless additional over-night accommodations are built at the ski base and busing is increased to and from Bozeman.

According to the Montana Department of Highways, there are no immediate plans to extend paving on Highway 86 to Wilsall, which would have a negative effect by increasing traffic on Bridger Canyon Road.

Recommendations: Establishment of limited community facilities: neighborhood convenience store, schools, meeting places, etc., will reduce dependence on Bozeman, hence reduce the vehicular load on the circulation system in the southwest corner of the planning area.

ROAD STANDARDS:

1. Arterial Roads: The Bridger Canyon, Jackson Creek and Kelly Canyon Roads are designated as arterial roads on the General Plan. Construction or upgrading of these roads should include:
 - a. Right-of-Way of sufficient size to contain: two paved travel lanes, shoulders, safety and snow storage strips, pathways for safe pedestrian-equestrian movements with ties to external trail systems, natural or man-made landscaping;
 - b. Re-vegetation of all snow storage areas and cut and fill slopes;
 - c. Erosion control measures including energy dissipaters for all drainage;
 - d. Outdoor advertising will not be seen from the parkway. Information and traffic signs, structures (i.e. bridges) and other road appurtenances will be designed and placed so as to express the respect for the quality of the environment embodied in the General Plan;
 - e. Trails: except where physically unfeasible, all parkways will be planned with trails paralleling the roadway and sometimes, radiating from it, designed for pedestrian-equestrian movement.
2. Secondary Roads:
 - a. Access to clusters developments and the ski base area shall include all previous considerations in 1 above, except shoulders and may be constructed on rights-of-way between 60 and 100 feet.
 - b. Adequate provision shall be made for traffic safety and sight distance at intersections with arterial roads.
 - c. Exceptions: access to all development clusters may be graveled or paved, with adequate drainage as described under Item 3, Private Drives.
 - d. Re-vegetation and weed suppression in all areas of road construction in accordance with Gallatin County standards.
3. Driveways serving less than five (5) dwellings:

Driveways may be unpaved with adequate measures used for erosion control. Where a driveway intersects a water course, adequate provision shall be made for culverts and bank protection. A permit must be obtained from the Soil Conservation Service where any road construction involves water courses. Driveways shall only intersect arterial roads at locations having appropriate sight distance for traffic safety. Re-vegetation and weed suppression measures must be in accordance with Gallatin County standards.

ROAD MAINTENANCE: Bridger Canyon Road is under the jurisdiction of the State Highway Department. Kelly Canyon, and Jackson Creek Roads fall under the jurisdiction of the Gallatin County Road Department, and are administered by the County Road Office. These roads are maintained on a regular basis. Paving improvements on Bridger Canyon Road are implemented according to wear. Kelly Canyon and Jackson Creek Roads, being gravel, are graded approximately four to five times annually, according to conditions. Paving along these roads can be completed through the County's Cost Sharing Improvement Program. In this program, the County will be responsible for the cost of paving 25 percent of the road, while property owners serviced by the road will equally divide the remaining 75 percent of the pavement expenses. The authority to recommend or initiate a road improvement is vested either in the property owners, who may petition for an improvement, or in the County Commissioners, who may initiate the proposal for an improvement.

SEWAGE DISPOSAL STANDARDS:

1. Design of septic tank systems shall adhere to Gallatin County standards except the minimum distance to any stream or any well from any leachfield will be 100 feet.
2. All sewage disposal systems shall be designated so that there is no direct discharge from said system to any water course.
3. Pit privies shall conform to State and County standards.

SOLID WASTE DISPOSAL STANDARDS: It is vital to fulfillment of this plan to have the cooperation of all concerned in order to prevent solid waste disposal problems. The anticipated population levels for Bridger Canyon will not begin to support a solid waste disposal operation. It is recommended that all solid wastes be exported to existing disposal facilities. Temporary storage of solid waste must be properly protected from bears.

PUBLIC SERVICES

LAW ENFORCEMENT: Police protection within the planning area is provided by the Gallatin County Sheriff's Office operating from their headquarters in Bozeman. No change is contemplated or warranted in this procedure.

FIRE PROTECTION: The Bridger Canyon area has created its own rural fire district. This service is supported through local property taxes within the district. The fire department has one station centrally located in the canyon. The station has three vehicles with a total water carrying capacity of 2,350 gallons. Presently there are six ponds located throughout the area that can supply additional water where needed. In addition, the Bridger Canyon Fire District has a mutual aid agreement with surrounding fire districts when additional water and manpower are needed for large fires. Surrounding property owners, not members of the Bridger Canyon Fire District may, upon petition join the district.

EDUCATION FACILITIES: School sites have been provided for in the planning area as outlined on the General Plan map. Presently, Malmborg Elementary School, located at the south end of Jackson Creek road is the only educational facility in the planning area. While there will probably never be a need for a high school if population levels are kept low, there may be a need for an additional elementary school in the future.

SCHOOL SITE STANDARDS: Standards are outlined in the Administrative Rules of Montana, Title 16, Chapter 10, Sub-Chapter 11, RULES FOR SCHOOLS.¹³

The school sites called for in the General Plan shall conform to suggested minimum area requirements. The area shall be sufficient to provide adequate space for all school facilities and activities. The land area for an elementary school should be five acres to serve up to 300 students plus one acre for each 100 additional students.

School sites should provide isolation from noise, dust, and traffic hazards. The sites should be easily accessible by walks and drives that are properly protected from traffic and other accident hazards.

Though not included in the Administrative Rules, yet equally important, are additional suggested standards for use in selecting or developing the school sites:

1. Where terrain on the site is rolling, school officials are cautioned to work with the landform as opposed to grading it into a single flat surface.
2. Retention of significant vegetative features is desirable.
3. Paved pathways, court game areas, parking lots and other areas where significant soil disruption is contemplated should be designated with provision for erosion and weed controls.

4. Architectural design and materials which fit the landscape of the canyon should be incorporated in the school designs.
5. School sites should have safe access and reliable snow removal.
6. Where possible, school sites should take advantage of solar heating and lighting potentials.

ADDITIONAL SERVICES: Other governmental services provided by Gallatin County include the typical activities of health, public works projects, recording, taxation and property assessment, planning and zoning regulation.

DESIGN CONCEPTS

COMMUNITY DESIGN: Several ideas have been developed concerning the clustering of housing developments. The advantages of such clustering are obvious. Land development costs are less with clustered site development. Cluster developments have common land which is an essential element of the development and is owned by an association of the homeowners. The liveability and visual appeal of such a development over the standard lot and block subdivision design is apparent.

By utilizing the clustering concept open space is preserved, which contributes strongly to the general visual character of the canyon. This open space is prohibited from development through the homeowners associations. One automatically becomes a member of a homeowners association when he/she purchases property. Development will only be allowed on a particular portion of the property he/she has purchased. The remaining land is grouped with that of the other homeowners and becomes common land to all.

ENVIRONMENTAL DESIGN: Preservation of open space is viewed as an integral part of the Bridger Canyon proposal. Strong efforts must be made to keep further development from destroying the open spaces. Residential development is not expected to locate in such a way as to duplicate the typical suburban spread of housing. Instead, efforts have been taken to encourage cluster development, thus allowing similar average densities while leaving generous open space. Such open space would be included under a management program to insure its protection and appearance.

Well conceived and strongly enforced land use planning is essential. The following planning suggestions are offered as a general guide:

<u>SITE CONDITION</u>	<u>IMPLICATION</u>
1. Sloping topography vegetated.	A. Better architectural expression possible on steeper topography (stepped housing).
	B. Potential exists to open small pockets in the vegetative cover with detached housing of cluster housing, thereby freeing large open meadows from development.
	C. Minor circulation routes, curvilinear to reflect the natural topography and to give a sense of containment.
2. Flat topography.	A. Potentially most economical site for housing development; however, "character" of site would be lost.

- B. Best site for public/commercial centers and open recreation requiring large areas.
 - C. Major circulation routes--as straight connectors focusing on vistas of focal points.
- 3. Low lying wetlands and stream areas.
 - A. Potential for water features; unbuildable in a practical sense.
 - B. Greatest value lies in passive recreational uses.
- 4. Open areas.
 - A. Potential to preserve agricultural land as features of the canyon by not allowing free building in any open area.
 - B. Emphasize views by using low building types - stepped along hillsides, clustered in covered areas.
 - C. Emphasize architectural quality to new structures. Reflects character of site through use of natural building materials.

DESIGN GUIDES: The following is not intended to be strict limitations on the type of development permissible, but is intended to constitute standards for proposed development.

1. Cluster Units.

- a. Develop with the natural features;
- b. Take advantage of sloping topography;
- c. Preserve sound, healthy trees and natural vegetation;
- d. Develop interest and variety in architectural silhouettes;
- e. Use harmonious varieties of architectural styles;
- f. Orient buildings toward views, where possible;
- g. Supplement native plants with harmonious landscaping;
- h. Provide for erosion and weed control;
- i. Use underground utilities;
- j. Do not disturb natural drainage flows;
- k. Preserve open space.

2. Neighborhood Commercial Areas.

- a. Structures design should be harmonious with residential structures;
- b. Break up wide expansive paved areas with trees and planting;
- c. Use harmonious signs throughout project;
- d. Unsightly service areas should be screened from public view;
- e. Setback parking areas from roads;
- f. Do not clutter development; provide ample room for expansion;

- g. Provide parking designed to handle the need.
3. High Density Residential Development - Ski Base Area
- a. Use and maintain natural features;
 - b. Design for above normal snowfalls;
 - c. Do not interfere with natural drainage channels;
 - d. Design for ease in snow removal from public areas;
 - e. Carry architectural theme throughout project;
 - f. Provide sufficient space and design to open areas.
4. Bridger Canyon Community Signs
- a. Type: rustic wood - natural dark stain;
 - b. Lettering: recessed (routed) - capital letters;
 - c. Size: not to interfere with or dominate area surrounding site of sign, and to comply with the zoning regulation;
 - d. Hanging: Wood posts;
 - e. Illumination: hooded spotlights directed to sign and not surround area;
 - f. Restrictions: no commercial advertising.ROADS

FOOTNOTES

- (1) For 30% slope, the land rises thirty (30) feet vertically for each 100 feet of horizontal measurement.
- (2) From Forward to "Soil Interpretations for land Use Planning and Development in Gallatin Valley Area." August, 1970.)
From information supplied by the U.S.G.S., Geology of the Bridger Range, Montana, published by the Geological Society of America.
- (3) From Consultant Report: "Harding, Miller, Lawson & Associates.
- (4) From "Hydrology of Gallatin River Drainage," U.S.D.A., S.C.S., Bozeman, Montana, 1972.
- (5) From "Montana Water Supply Outlook", U.S.D.A., S.C.S., Bozeman, Montana, June 1, 1987.
- (6) NOTE: See a report entitled, "Studies of the Diurnal Wind and Temperature Regimes Above Mountain Slopes," U.S. Department of Commerce, July 31, 1969, for detailed climatic information for northern Bridger Canyon.
- (7) Source: "Geology and Ground-Water Resources of Gallatin Valley, Gallatin County, Montana," USGS Water Supply Paper 1482, 1960.
- (8) Source: Sub-Chapter 6; Surface Water Quality Standards, title 16, Chapter 20; Water Quality Administrative Rules of Montana, Water Quality Bureau, Environmental Sciences Division, Montana Department of Health and Environmental Sciences.
- (9) Source: "The Bozeman Master Plan," Bozeman City-County Planning Board, November, 1983.
- (10) Note: Land use permits were imposed to insure that any and all construction in the Bridger Canyon Planning area is in accordance with the provisions outlined in the Zoning Regulation.
- (11) Note: According to the 1980 United States Population Census, the average number of persons per dwelling unit in Gallatin County is 2.5.
- (12) Note: Maximum figure held to 4,500 due to an imposed limit on ski base parking. Full expansion to Bridger Bowl Ski Association estimate of 8,000 day users would require bussing from nearby population centers and additional parking areas for those busses.
- (13) Additional information can be obtained from the Montana Department of Health and Environmental Sciences, Environmental Sciences Division, Food and Consumer Safety Bureau, Helena MT 59620.

- (14) Source: "Blue Ribbons of the Big Sky Country Areawide Planning Organization," Final Report and Water Quality Management Plan, August, 1979.
- (15) Source: "Soil Interpretations for Land Use Planning and Development in the Gallatin Valley Area, Montana" U.S. Department of Agriculture, Soil Conservation Service (August 1970).

APPENDICES

Appendix A

DETAILED SOIL DESCRIPTION FOR BRIDGER CANYON

BRIDGER SERIES

The Bridger soils are most extensive on the foothills and alluvial fans of the Bridger, Gallatin and Madison ranges. These soils comprise about 10 percent of the area. They developed in loam or clay loam materials on upland fans and terraces. Elevation ranges from 4500 to 6000 feet. Mean annual precipitation is 18 to 24 inches. These are well-drained, dark colored soils. They have a moderately thick loam surface and a thick clayey subsoil. The subsoil is underlain by calcareous, stony and gravelly loam to a depth of 60 inches. Gravel, cobble and stone comprise 5 to 30 percent of the volume throughout the soil profile.

(Bm) BRIDGER LOAM

The soil is on alluvial fans and foot slopes with slopes of 2 to 30 percent. The dark colored loam surface layer is about 8 inches thick. The clayey subsoil is 16 to 24 inches thick. Depth to calcareous material varies from 24 to 32 inches. The subsoil is underlain by stony and gravelly loam.

This soil is used mainly for small grain, hay, grazing and wildlife.

(Bc) BRIDGER SILTY CLAY LOAM

The soil is on alluvial fans and foot slopes with slopes of 2 to 30 percent. The dark colored silty clay loam surface layer is about 8 inches thick. The silty clay subsoil is 16 to 24 inches thick. Depth to calcareous material varies from 24 to 32 inches. The subsoil is underlain by stony and gravelly loam.

This soil is used mainly for small grain, hay, grazing and wildlife.

(Br) BRIDGER GRAVELLY LOAM

This soil is on alluvial fans and foot slopes with slopes of 2 to 30 percent. It is similar to the Bridger loam except for the increased gravel content in the soil. The nitrogen, phosphorus and calcium content is generally less than that of the Bridger loam.

This soil is used mainly for small grain, grazing and wildlife.

(Bs) BRIDGER STONY LOAM

This soil is on alluvial fans and foot slopes with slopes of 0 to 20 percent. The dark colored stony loam surface layer is about 8 inches thick. The stony, gravelly and cobbly sandy clay loam subsoil is 16 to 24 inches thick. Depth to calcareous material ranges from 24 to 32 inches.

This soil is used mainly for grazing and wildlife.

GALLATIN SERIES

The Gallatin soils are most extensive in areas bordering the Gallatin and East Gallatin rivers and Reese, Bridger and Bozeman creeks. These soils comprise about 7 percent of the area. They developed in calcareous silt loam materials on low stream terraces. Elevation ranges from 4500 to 6000 feet. Mean annual precipitation is 14 to 20 inches. These are somewhat poorly to poorly drained, dark colored soils. They have a moderately thick silt loam surface layer and a thick silt loam or clay subsoil. The subsoil is underlain by loose sand and gravel at depths between 30 and 60 inches.

(Gc) GALLATIN SILTY CLAY LOAM

This soil is on low stream terraces with slopes of 0 to 2 percent. It is similar to the typical Gallatin silt loam except the surface layer has a silty clay loam texture and the subsoil has a silty clay texture.

This soil is used mainly for small grain, hay, pasture and wildlife.

(Gs) GALLATIN SILT LOAM

This soil is on low stream terraces with slopes of 0 to 2 percent. The dark colored silt loam surface layer is about 8 inches thick. The silty clay loam subsoil is 22 to 32 inches thick. Depth to loose sand and gravels is 30 to 40 inches.

This soil is used mainly for small grain, hay, pasture and wildlife.

(Gs) GALLATIN SILT LOAM, SWAMPY PHASE

This soil is on low stream terraces with slopes of 0 to 2 percent. It is similar to the typical Gallatin silt loam except this soil has a permanent swampy condition because of seepage or for production of small grains and hay.

This soil is used mainly for grazing and wildlife.

HAVRE SERIES

The Havre soils are most extensive in better drained areas on low terraces. These soils comprise about 4 percent of the area. They developed in calcareous sandy materials of recent origin. Elevation ranges from 4000 to 5000 feet. Mean annual precipitation is 10 to 18 inches. These are light to dark colored, moderately well-drained soil. They have a moderately thick fine sandy loam to loam surface layer and a thick fine sandy loam to silty clay loam subsoil. The subsoil is underlain by loose sand and gravel at depths between 30 and 60 inches.

(Hf) HAVRE FINE SANDY LOAM

This soil is on low stream terraces with slopes of 0 to 2 percent. The dark colored fine sandy loam to loam surface layer is about 8 inches thick. The fine sandy loam subsoil is 22 inches or more in thickness. Scattered gravels occur on the surface in some areas.

This soil is used mainly for small grain, hay, pasture and wildlife. (15)

Appendix B

EXPLANATION OF TABLE 1

"ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES."

The map symbols and names of soils given at the top of Table 1 are keyed to the soil classification map for Bridger Canyon. Soils are rated for each of 16 selected uses shown at the left of the table. The soil information used for this study is based on the 1931 U.S.D.A. Soil Survey for the Gallatin Valley area, Montana.

Soils rated as slight are relatively free of limitations or have limitations that are easily overcome. Soils rated as moderate have limitations that need to be recognized but can be overcome with good management and careful design. A severe rating indicates limitations that are difficult or costly to overcome. A severe rating does not mean the soil cannot be used for a specific use, but it means that careful planning and design and very good management are needed. In some cases, severe limitations are not economically feasible to correct.

Numbers following ratings of moderate and severe are keyed to 15 limiting properties listed on pages facing Table 1. These numbers identify the major properties which determine the limitations of a particular soil.

All interpretations are based on the upper 5 feet of soil material in its natural state unless otherwise noted. Geologic reports can be of benefit for evaluating material below 5 feet.

Unlike modern soil surveys, the 1931 survey does not separate soil areas that are nearly level from those with steeper slopes. Thus, slope percentage must be measured in the field or obtained from topographic maps. Table 1 shows that Amsterdam silt loam, for example, has slight limitations for cropping, moderate limitations if slopes are 5 to 9 percent and severe limitations if slopes exceed 9 percent. Other soils such as Bridger stony loam, although they also occur on a variety of slopes, have other limitations such as extreme stoniness which over-ride the problems of slope. Still, other soils such as the Beaverton series occur only on nearly level areas and therefore are not limited by the slope factor.

The 16 selected uses of soil and the properties considered important in evaluating soils for each use are given below:

CROPPING is based on the capability of the soils, when properly managed, to sustain cropping without risks of serious soil damage. It is affected by factors such as soil texture, depth, permeability, available water holding capacity, flooding or ponding hazards, salinity and alkalinity, slopes and erosion hazard.

ROAD AND STREET LOCATION is affected by depth to seasonal high water table, flooding hazard, load-bearing capacity, frost action potential, stoniness, depth to bedrock and topography.

FOUNDATIONS FOR LOW BUILDINGS WITH BASEMENTS are affected by soil properties and other related factors such as soil texture and density of the subsoil and substratum, flooding or ponding hazards, seasonal high water table, slopes as related to cuts and fills, depth to bedrock and differential settling of moved material. This soil interpretation does not take into consideration the use of on-site sewage disposal systems.

LAWNS AND LANDSCAPING are influenced by soil properties such as texture, depth to seasonal high water table, flooding hazard, depth to bedrock, stoniness, salinity or alkalinity of the surface 12 inches.

PARKING AREAS are affected by properties such as depth to seasonal high water table, flooding hazard, load-bearing capacity, frost action potential, stoniness, depth to bedrock and topography.

CAMP AREAS for recreation are subject to heavy foot and some vehicular traffic during the camping season. Soil properties and related factors of importance are depth to seasonal high water table, flooding or ponding hazards, permeability, slope, soil texture, stoniness, and degree of rockiness.

PICNIC AREAS for recreation are subject to heavy foot traffic. It is assumed that most vehicular traffic will be confined to access roads. Soil properties and other related factors of importance are depth to seasonal high water table, flooding hazard, slope, soil texture, stoniness and degree of rockiness.

PLAYGROUNDS for recreation are subject to heavy foot traffic. Soil properties and other related factors of importance are soil texture, depth to seasonal high water table, flooding or ponding hazards, depth to bedrock, stoniness and topography.

SEPTIC TANK FILTER FIELDS are influenced by the ease of movement of effluent through the soil. Related factors are seasonal high water table, flooding hazard, slope, depth to bedrock, hydraulic conductivity and ground water contamination hazard.

SEWAGE LAGOONS are rated on the adequacy of the soil material to prevent water seepage from the lagoon. Soil characteristics affecting sewage lagoons are hydraulic conductivity, slope, depth to bedrock, coarse fragments, stoniness, soil texture and organic matter.

SANITARY LAND FILLS are designed to operate without contaminating water supplies or causing health hazards. Important soil related factors are texture, seasonal high water table, depth to bedrock and topography.

CEMETERIES are affected by soil properties and other related factors such as seasonal high water table, flooding hazard, depth to hard rock, slope, stoniness and soil texture.

POND RESERVOIR AREA is rated on the adequacy of the soil material to prevent water seepage from the reservoir. Soil properties most important are hydraulic conductivity and seepage rate, depth to water table, and organic matter content.

FILL MATERIAL OTHER THAN EMBANKMENT is rated on the basis that the material is removed and transported to another location to be used as fill material. Important factors are texture, stoniness, soil depth, seasonal high water table, frost action potential, salinity and alkalinity.

POND EMBANKMENT MATERIALS are those features of disturbed soils that affect their suitability for constructing earth fills. These include compaction characteristics, compacted permeability, susceptibility to piping, salinity and alkalinity and organic matter content.

TOPSOIL is rated on soil properties such as texture, thickness of the surface layer, presence of coarse fragments, organic matter content, wetness of the surface layer, salinity and alkalinity.

LIMITING SOIL PROPERTIES AND HAZARDS FOR DETERMINING ESTIMATED SOIL
LIMITATIONS FOR SELECTED USES, TABLE 1

1. Frequency of flooding or surface ponding.
2. Seasonal ground water table within 3 feet.
3. Slope percentage:
 - a. less than 2
 - b. 2 to 5
 - c. 5 to 9
 - d. less than 9
 - e. more than 9
 - f. 9 to 15
 - g. more than 15
4. Relief.
5. Load bearing capacity.
6. Hydraulic conductivity (inches per hour):
 - a. 0.20 to 0.63
 - b. 0.63 to 2.00
 - c. more than 2.00
7. Susceptibility to piping:
 - a. Moderate
 - b. High
8. High organic matter content.
9. Frost action potential:
 - a. Moderate
 - b. High
10. Salinity and alkalinity.
11. Ground water pollution.
12. Coarse fragments (gravel, cobble or stones).
13. Depth to loose sand or sand and gravel.

14. Soil texture.
15. Depth to bedrock (less than 40 inches).

NOTE: These interpretations are for general planning. On-site investigation is needed for specific design and construction.

TABLE 1

Estimated Soil Limitations or Suitability for Selected Uses

Map Symbols & Soil Names*	(Bc) Bridger silty clay Loam (Bm) Bridger loam (Br) Bridger gravelly loam	(Gc) Gallatin silty clay loam (Gs) Gallatin Silt loam	(Gs) Gallatin Silt loam, swampy phase
<u>Limitations For:</u> Cropping	Slight Moderate 3c Severe 3e	Moderate 1, 2	Severe 2
Road & Street Location	Moderate 5, 8, 9a Severe 3g	Severe 1, 2, 9b	Severe 2
Urban development -foundations for low buildings w/basements -lawns and landscaping -parking areas	Slight Moderate 3f Severe 3g Slight Moderate 3f Severe 3g Moderate 3b & c, 5, 8, 9a Severe 3e	Severe 1, 2 Severe 1, 2 Severe 1, 2, 9b	Severe 2 Severe 2 Severe 2
Recreation -camp areas -picnic areas -playgrounds	Slight Moderate 3c & f Severe 3g Slight Moderate 3e Slight Moderate 3b Severe 3c	Severe 1, 2 Moderate 1 Severe 1	Severe 2 Severe 2 Severe 2

	Table I (Continued)		
Map Symbols & Soil Names*	(Bc) Bridger silty clay loam (Bm) Bridger loam (Br) Bridger gravelly loam	(Gc) Gallatin silty clay loam (Gs) Gallatin silt loam	(Gs) Gallatin silt loam, swampy phase
Waste Disposal			
-Septic tank filter fields	Moderate 6b Severe 3c	Severe 1, 2, 11	Severe 2, 11
-sewage lagoons	Moderate 6b Moderate 3b, c, 6b Severe 3e	Severe 6c, 8, 11	Severe 2, 11
-sanitary land fills	Slight Moderate 3f Severe 3g	Severe 1, 2, 11	Severe 2, 11
Other Uses			
-cemeteries	Slight Moderate 3f Severe 3g	Severe 1, 2	Severe 2
-pond reservoir area	Moderate 6b	Severe 6c	Severe 6c
<u>Suitability as Source of:</u>			
Fill material other than embankment	Fair to Good	Poor 8, 9b	Poor 2
Pond embankment material	Good	Poor 1, 7b, 8	Poor 2
Top Soil	Good	Good	Poor 2

* Names of soils are tentative and subject to change.

NOTE: These interpretations will not eliminate the need for on-site soil investigations for design and construction.

Above Table from: Soil Interpretations for Land Use Planning and Development in the Gallatin Valley Area, Montana--U.S. Department of Agriculture Soil Conservation Service.

Appendix C

SOIL DEVELOPMENT GUIDELINES

<u>Soil Classification</u>	<u>Development Guides</u>
Bc - Bridger silty clay loam Bm - Bridger loam Br - Bridger gravelly loam	These soil units indicate no specific problems for either road or building construction. As they are generally unable to support waste disposal fields, specific engineering tests should be conducted prior to construction.
Gs - Gallatin silt loam Gs - Gallatin silt loam, swampy phase	High ground water tables and possible surface ponding can cause foundation construction problems--engineering foundation tests should be required for both road and building construction. These soils units are definitely not suitable for waste disposal field locations.
Rb - Rough broken & mountainous land - Riverwash	These soil units are too variable to evaluate. Further study should be required for specific locations. Considerable gravel can be scattered over the surface and throughout the soil.
Hf - Havre fine sandy loam	If there is a frequency of flooding, these soil units can present construction problems; however, generally they are reasonably stable. Site conditions can vary--tests should be required for heavy foundations and locations for waster disposal fields.

NOTE: The surface soil deposits have been found to be extremely variable in permeability. This has an effect on both the quantity of water available in shallow domestic wells and the successful operation of individual sewage drainfields.

Appendix D

insert the snowfall map

Appendix E

insert the snow load map

Appendix F

WATER QUALITY FOR BRIDGER CREEK

The following water quality tests were taken on May 21, 1986, on Bridger Creek at the Kelly Canyon Road Bridge. The tests were conducted by Sohio Petroleum Company and Inter-Mountain Laboratories:

Lab pH, s.u.	8.1	
Lab Conductivity, umhos/cm @25C	228	
Total Dissolved Solids (105C),mg/1	154	
Total Dissolved Solids (180C),mg/1	152	
Total Dissolved Solids (calc),mg/1	133	
Sodium Adsorption Ration	0.26	
Total Alkalinity as CaCO ₃ , mg/1	121	
Total Harness as CaCO ₃ , mg/1	120	
Sulfide, mg/1	<0.04	
Ortho-Phosphate as P, mg/1	1.03	
Acidity as CaCO ₃ , mg/1	<1	
Oil & Grease, mg/1	<1	
Total Suspended Solids, mg/1	172	
Turbidity, NTU	55	
Total Kjeldahl Nitrogen, mg/1	1.02	
Major Ions:	mg/1	meq/1
Bicarbonate as HCO ₃	148	2.43
Carbonate as CO ₃	0	0.00
Chloride	1	0.03
Fluoride	0.01	0.00
Nitrate +Nitrite as N	0.05	0.00
Sulfate	9	0.19
Calcium	37	1.83
Magnesium	7	0.57
Potassium	<1	-
Sodium	7	0.29
Major Cations		2.69
Major Anions		2.65
Cation/Anion Difference (Percent)		0.75
Trace Metals, Dissolved, mg/1		
Arsenic	<0.005	
Barium	<0.5	
Cadmium	<0.002	
Chromium	<0.02	
Cobalt	<0.02	

Iron	0.09
Lead	<0.02
Manganese	<0.02
Mercury	<0.001
Nickel	0.01
Zinc	<0.01

Appendix G

WATER MANAGEMENT PRACTICES

IRRIGATION PASTURES AND HAY LAND

Definition

Irrigated pasture and hay lands are those lands used for the production of forage plants to be grazed or harvested for hay on which the natural precipitation is supplemented with additional water. This section includes sub-irrigated lands.

Management Practices

1. Provide for irrigation water management.
2. Use pasture and hay land management to obtain adequate plant cover.

Construction Practices

The following practices will be used to conserve water, control soil erosion, and production of pollutants into groundwater, streams, and rivers:

1. Structures for water control.
2. Irrigation sprinkler systems.
3. Irrigation field ditch.
4. Irrigation ditch or canal lining.
5. Irrigation pipelines.

Dry Pasture and Hayland

Definition

Pasture and haylands are those lands used for the production of plants for hay or pasture where natural precipitation is the only source of water.

Management Practices

1. Use proper grazing to maintain adequate plant cover.
2. Re-establish pasture and haylands to obtain adequate plant cover.

Construction Practices

The following practices will be used to control soil erosion and production of pollutants to streams and rivers:

1. Gully erosion control.
2. Critical area seeding.
3. Fencing.

Rangeland

Definition

This land includes grazeable woodlands and all other lands that are grazed which are dominated by native vegetation consisting of grasslike plants, forbs and shrubs.

Management Practices

1. Proper grazing will be used to maintain adequate plant cover.
2. Defined grazing or defined vegetational grazing will be used to obtain adequate plant cover.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into streams and rivers:

1. Fencing.
2. Gully erosion control.
3. Critical area seeding.

Wildlife lands

Definition

These areas consist of lands and waters that are used primarily for the production and conservation of wildlife.

Management Practices

1. Proper grazing will be used to maintain adequate plant cover.
2. Wildlife will be managed to maintain adequate plant cover.

Recreation lands

Definition

These areas consist of land and water areas which are primarily used for recreation.

Management Practices

1. Protect and/or maintain adequate vegetative cover.
2. Protect existing vegetated waterways.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into ponds, lakes, streams and rivers.

1. Mechanical slope stabilization.
2. Re-vegetation.
3. Vegetated or lined channel.
4. Heavy use area protection.
5. Sediment and debris basin.
6. Grade stabilization structures.

Urban lands

Definition

Urban lands are those lands used for or being converted for use to residential, institutional, industrial or other community purposes.

Management Practices

1. Protect and/or maintain adequate vegetative cover.
2. Maintain and/or protect existing vegetated waterways.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into ponds, lakes, streams and rivers.

1. Re-vegetation.
2. Critical area planting.
3. Sediment and debris traps or basins.
4. Ditches, diversions and dikes.
5. Surface and sub-surface drainageways.
6. Drainage land grading.
7. Heavy use area protection.
8. Grade stabilization structures.
9. Vegetated or lined channels and floodways.
10. Season of construction.

Mined Lands

Definition

These lands consist of areas mine disturbed or used for the stockpiling of residues in production of gravel, coal, uranium, or other minerals.

Management Practices

1. Protect and maintain adequate vegetative cover.
2. Maintain and protect existing vegetated waterways and channels.

Construction Practices

These practices will be used to control escapement of mined wastes, sediment, and other pollutants into groundwater, lakes, ponds, streams, and rivers.

1. Re-vegetation.
2. Sediment and debris basin.
3. Access roads.
4. Diversions and dikes.
5. Dams.
6. Fencing.
7. Floodwater diversion.
8. Floodwater retarding structure.
9. Floodways.
10. Grade stabilization structure.

11. Vegetated or lined waterways and outlets.
12. Holding Pond.
13. Critical area planting.

Forest Lands

Definition

These lands include those areas on which the predominate vegetation consists of trees. Timber may have commercial value. Wildlife, recreation, and livestock grazing may have an associative commercial value.

Management Practices

1. Protect and/or maintain vegetative cover on critical areas.
2. Protect and maintain vegetated waterways.
3. Plan access roads to avoid fragile areas.
4. Select proper logging methods.

Construction Practices

These practices will be used to control soil erosion and deposition of debris and sediment into streams and rivers.

1. Proper slash disposal.
2. Critical area planting.
3. Proper location of skid trails.
4. Proper road construction and location.
5. Mechanical slope stabilization.
6. Proper location of drainages.
7. Re-vegetation.
8. Debris and sediment traps.

Roadways

Definition

These areas include all lands used as corridors for a transportation network.

Management Practices

1. Roadbeds will be properly constructed and located.
2. Protect and maintain vegetated waterways.

Construction Practices

The following practices will be used to trap sediment, pollutants and soil erosion:

1. Proper shaping of embankments and borrow pits.
2. Grad stabilization structures.
3. Diversions.
4. Proper locations of drainage structures.
5. Mechanical slope stabilization.
6. Re-vegetation.

7. Vegetated or lined channels and floodways.

Stream Corridors

Definition

The stream corridor is that land used to provide for a naturally functioning stream channel and vegetated buffer strip.

The minimum width of this stream corridor will be determined from Keith McLaughlin's "Minimum Ground Line Distance from Disturbance to Stream Channel for Various Precipitation Zones, Ground Cover and Slope Classes."

Management Practices

1. A stream corridor will be developed.
2. Vegetated stream corridors will be protected.
3. Stream corridors will not be overgrazed.
4. Minimum stream flows will be maintained.

Construction Practices

The following practices will be used to trap and/or control sediment, pollutants and soil erosion.

1. Stream bank protection.
2. Livestock exclusion.
3. Re-vegetation.
4. Water control structures.

Solid and Liquid Wastes

Definition

This includes all management, disposal and utilization of liquid or solid wastes resulting from man's activities.

Management Practices

1. Site waste disposal facilities.
2. Locate livestock feeding areas or holding pens away from stream corridors.

Construction Practices

The following practices will be used to control production of pollutants to groundwater, streams and ponds:

1. Waste management systems.
2. Waste storage structures.
3. Waste storage ponds.
4. Waste treatment lagoons.
5. Sediment and debris basins.
6. Dikes.
7. Diversion.
8. Floodwater diversions.

9. Irrigation systems.(14)

SUN CHART

BRIDGER CANYON, MONTANA

The following information refers to pertinent data regarding sun angle and intensity over the study area. Such information is useful to planning in the area. It is obvious from this chart that in the month of July the sun is at its maximum intensity and highest on the horizon.

AZIMUTH - angle of sun's rays in plan

TIME OF YEAR	10 A.M	3 P.M.
Spring (April)	46 degrees East of S	62 degrees W of S
Summer (July)	53 degrees	70 degrees
Fall (October)	33 degrees	47 degrees
Winter (January)	29 degrees	43 degrees

ALTITUDE - true angle of sun's rays with horizontal

TIME OF YEAR	10 A.M.	NOON	3 P.M.
Spring (April)	47 degrees	55 degrees	40 degrees
Summer (July)	54 degrees	64 degrees	45 degrees
Fall (October)	26 degrees	33 degrees	18 degrees
Winter (January)	19 degrees	24 degrees	12 degrees

Appendix H

BEST MANAGEMENT PRACTICES FOR FORESTRY IN MONTANA

ROADS

1. LOCATION

1. Minimize the number of roads constructed in a watershed through comprehensive road planning, recognizing intermingled ownership and foreseeable future uses. Use existing roads where practical.
2. Fit the road to the topography. Locate roads on natural benches and stable soil types to minimize the area of road disturbance.
3. Locate roads on well drained soils and rock formations that tend to dip into the slope. Avoid slide-prone areas characterized by seeps, steep slopes, highly weathered bedrock, clay beds, concave slopes, hummocky topography, and rock layers that dip parallel to the slope.
4. Avoid high erosion hazard sites, such as steep narrow canyons, slide areas, slumps, swamps, wet meadows, or natural drainage channels. Where there is potential for material to enter a stream, obtain approval of the Conservation District and/or the Water Quality Bureau under applicable laws (i.e., 310 Permit, Turbidity Authorization).
5. Locate roads a safe distance from streams when roads are running parallel to stream channels. Provide an adequate SMZ in order to catch sediment and prevent its entry into the stream.
6. Minimize the number to stream crossings.
7. Cross streams at right angles to the main channel if practical.
8. Choose a stable stream crossing site and adjust the road grade to reach the site if possible.
9. Avoid unimproved stream crossings. Where a culvert or bridge is not feasible, locate drive-throughs on a stable, rocky portion of the stream channel.
10. A 310 permit (Natural Streambed and Land Preservation Act of 1975) is required before disturbance is allowed within the area between the normal high water mark of perennial streams.

11. Avoid long, sustained, steep road grades. Where unavoidable, establish effective water bars and sediment diversions.
12. Vary road grades to reduce concentrated flow in road drainage ditches and culverts and to reduce erosion on cut and fill slopes and road surface.
13. When locating roads, provide access to suitable log landing areas (flatter, well drained) in order to reduce soil disturbance.

2. DESIGN

1. Incorporate preventative action into transportation plans. Minimize disturbance. Use available information to help identify erodible soils, unstable areas, and road surface materials.
2. Plan roads to minimum standard necessary to accommodate anticipated use and equipment. When using existing roads, avoid reconstruction unless absolutely necessary. The need for higher standard roads can be alleviated through better road use management.
3. Construct, cut and fill slopes at stable angles.
4. Use plans that balance cuts and fills or use full bench construction (no fill slope) where stable fill construction is not possible. Haul excess material to a safe disposal site and include these waste areas in soil stabilization planning for the road.
5. Contour and roll road grades for minimal disruption of drainage patterns.

3. DRAINAGE

1. Design water crossing structures at points where it is necessary to cross stream courses. Provide for adequate fish passage, minimum impact on water quality, and at a minimum, the 25 year frequency runoff. Get a 310 permit for perennial stream crossings.
2. Install culverts to conform to the natural streambed and slope. Place culverts slightly below normal stream grade to avoid culvert outfall barriers.
3. Design culvert installations to prevent erosion of fill. Compact the fill material to prevent seepage and failure. Armor the inlet and/or outlet with rock or other suitable material where needed.
4. Provide adequate drainage for the road surface. Use outsloped roads, insloped road with ditches and crossdrains, or drain dips. Dips should be constructed deep enough into the subgrade that traffic will not obliterate them.

5. Plan ditch gradients steep enough, generally greater than 2%, but less than 8%, to prevent sediment deposition and ditch erosion. Gradient depends on parent material.
 6. Design the spacing of road drainage facilities based on geologic type, soil erosion class, and road grade.
 7. Where possible, install ditch relief culverts at the gradient of the original ground slope; otherwise anchor downspouts to carry water safely across the fill slope.
 8. Skew relief culverts 20 to 30 degrees toward the inflow from the ditch to provide better inlet efficiency.
 9. Provide energy dissipators where necessary about downstream end of ditch relief culverts to reduce the erosion energy of the emerging water.
 10. Protect the upstream end of crossdrain culverts from plugging with sediment and debris. Prevent downslope movement of sediment by using sediment catch basins, drop inlets, changes in road grade, headwalls, and recessed cut slopes.
 11. Install culverts to assure protection from crushing due to traffic. Use 1 foot minimum cover for CMP's 15 to 36 inches in diameter, and a cover of one-third diameter for larger CMP's.
 12. Use CMP's with a minimum diameter of 15 inches to avoid plugging.
 13. Install road drainage facilities above stream crossings so water may be routed through a SMZ before entering stream.
4. CONSTRUCTION
1. Place debris, overburden, and other waste materials associated with construction activities in a location to avoid entry into streams.
 2. Minimize stream channel disturbances and related sediment problems during construction of roads and installation of stream crossing structures. Do not place easily eroded material into live streams. Remove material stockpiled on a floodplain before rising water reaches the stockpile. Locate bypass roads to have minimal disturbance on the stream course. Limit construction activity to specific times to protect beneficial water uses.
 3. Minimize earth moving activities when soils appear excessively wet. Do not disturb roadside vegetation more than necessary to maintain slope stability and to serve traffic needs.
 4. Clear all vegetative material before constructing the fill portion of the road prism.

5. On potentially erodible fill slopes, windrow slash at the toe of the fill slopes to trap sediment, particularly near stream crossings and on erodible fill slopes.
6. Stabilize erodible, exposed soils by seeding, compacting, riprapping, benching, mulching, or other suitable means prior to fall or spring runoff.
7. Keep slope stabilization, erosion and sediment control work as current as possible with road construction.
8. Install drainage structures concurrent with construction of new roads and always prior to fall or spring runoff.
9. Complete or stabilize road sections within the same operating season.
10. Minimize sediment production from borrow pits and gravel sources through proper location, development, and reclamation.

5. MAINTENANCE

1. Grade road surfaces as often as necessary to maintain a stable running surface to retain the original surface drainage.
2. Avoid cutting the toe of stable cut slopes when grading roads or pulling ditches.
3. When plowing snow for winter timber harvest, provide breaks in snow berm to allow road drainage.
4. Keep erosion control measures functional through periodic inspection and maintenance.
5. Haul all excess material removed by maintenance operations to safe disposal sites. Apply stabilization measures to these sites to prevent erosion. Avoid side casting material where it will enter a stream or be available to erode directly into a stream.
6. Leave closed roads in a condition that provides adequate drainage without further maintenance.
7. Restrict the use of roads during wet periods and spring breakup period if damage to road drainage features resulting in increased sedimentation is likely to occur.

TIMBER HARVESTING AND REFORESTATION

1. HARVEST DESIGN

1. Consider the following during development of timber harvest systems:
 - a. Soil characteristics and erosion hazard identification.
 - b. Rainfall characteristics.
 - c. Topography.
 - d. Plant cover (forest type understory, silvics).
 - e. Critical components (aspect, water courses, landform, etc.).
 - f. Silvicultural objectives.
 - g. Existing watershed condition.
 - h. Potential effects of multiple resource management activities on beneficial water uses.
 - i. Compliance with Montana Water Quality Act, State Water Quality Standards and Public Water Supply Act. Manage community and non-community public water supply watersheds to comply with State Water Quality Standards. The Public Water Supply Act (75-6--101-MCA) requires approval of plans and specifications for road and other disturbance from the Water Quality Bureau for activities planned for public water supply watersheds.
2. Leave streamside management zones (SMZs) (see definition) on both sides of perennial streams and intermittent streams with a well defined channel. This zone provides shading, soil stabilization, and sediment and water filtering effects.
3. Use the logging system that best fits the topography, soil type, and season, while minimizing soil disturbance and economically accomplishing silvicultural objectives. Consider the potential for erosion prior to tractor skidding on slopes greater than 40%.
4. Design and locate skid trails and skidding operations to minimize soil disturbance. The use of designated skid trails is one means of limiting site disturbance and soil compaction.
5. Locate skid trails to avoid concentrating runoff and provide breaks in grade.
6. Locate skid trails and landings away from natural drainage systems and divert runoff to stable areas.
7. Use the economically feasible yarding system which will minimize road densities.

2. HARVESTING ACTIVITIES

1. Avoid falling trees or leaving slash in streams or water bodies.
2. Limb or top trees where debris cannot fall or be dragged into the stream.

3. Ground skidding through any perennial stream is not allowed except by permit from the Conservation District (Natural Streambed and Land Preservation Act of 1975 - 310 permit).
4. Minimize operation of wheeled or tracked equipment within the streamside management zones (SMZ) of stream courses designated for protection. Do not operate equipment on stream banks.
5. End-line logs out of streamside areas when ground skidding systems are employed.
6. Logs will be fully suspended when line skidding across a stream and immediately above streambanks.
7. Remove debris entering any stream concurrently with the yarding operation and before removal of equipment from the project site. Accomplish debris removal so the natural streambed conditions are not disturbed. Leave natural occurring downfall material providing fish habitat.
8. Avoid equipment operation in wetlands, bogs, and wet meadows except on designated roads. Use end-lining and directional falling for harvest operations in these areas.
9. Repair damage to a stream course caused by logging operations, including damage to banks and channel, to be reasonable condition as possible without causing additional damage to the stream channel.
10. Tractor skid when compaction, displacement, and erosion will be minimized.
11. Install necessary water bars on tractor skid trails prior to expected periods of heavy runoff. Appropriate spacing between bars is determined by the soil type and slope of the skid trail. Timely implementation is important.
12. Construct drainage structures on skid trails to prevent water and sediment from being channeled directly into stream courses.
13. Construct water bars and/or seed skid trails and landings, where natural revegetation is inadequate to prevent accelerated erosion, before the next growing season. A light ground cover of slash or straw will help retard erosion.
14. Avoid skidding with the blade lowered.
15. Suspend the head end of the log whenever possible.
16. Minimize the size and number of landings to that necessary for safe, economical operation.

17. Avoid decking logs within the high water mark of any stream.
18. Provide suitable delivery, storage, and disposal for all fuels, shop debris, waste oil, etc.

3. SLASH TREATMENT AND SITE PREPARATION

1. Rapid reforestation of harvested areas is encouraged to re-establish protective vegetation.
2. Use brush blades on cats when piling slash. Avoid use of dozers with angle blades. Site preparation equipment producing irregular surfaces are preferred. Care should be taken to avoid severe disruption of the surface soil horizon.
3. Minimize or eliminate elongated exposure of soils up and down the slope during mechanical scarification.
4. Scarify the slope to the extent necessary to -- reforestation objective of the site. Low slash and small -- should be left to slow surface runoff, return soil nutrients and provide shade for seedlings.
5. Carry out brush piling and scarification when soils are dry enough to minimize compaction and displacement.
6. Carry out scarification on steep slopes in a manner that minimizes erosion. Broadcast burning and/or herbicide application is a preferred means for site preparation on slopes greater than 40%.
7. Maintain an SMZ between site preparation or slash disposal areas and streams.
8. Scarify landings and temporary roads on completion of use.
9. Do not apply chemical vegetation control treatments to water bodies. Provide suitable buffer strips between chemical mixing and application areas and all water bodies.
10. Apply pesticide and dispose of containers according to label and EPA registration directions. Make contingency plans to follow in case of accidental spills. Mixing and disposal of chemical should be supervised by a licensed applicator.
11. Limit water quality impacts of prescribed fire: construct water bars in firelines; reduce fuel loadings in drainage channels; maintain the streamside management zone; avoid intense fires unless needed to meet silvicultural goals.

FIRE SUPPRESSION

1. Minimize watershed damage from fire suppression by avoiding heavy equipment operation on fragile soils and steep slopes.
2. Stabilize suppression damage where erosion potential has increased. Treatments include installing water bars, seeding, planting, fertilizing, spreading slash or mulch on bare soil, repairing road drainage facilities, and clearing stream channels of debris.
3. Conduct burn area surveys where necessary to assess the need for rehabilitation of watershed damage. Rehabilitation measures may include: seeding, fertilizing, fencing, clearing debris from stream channels, constructing trash racks, channel stabilization structures and debris retention structures.
4. Consider the impacts of sewage disposal when establishing locations for fire camps, logging camps, or other similar facilities.

Appendix I

insert Land Use Maps page here

Appendix J

insert Land Ownership Map here

Appendix K

AGENCIES FOR ADDITIONAL INFORMATION

Bozeman Chamber of Commerce
1205 East Main
Bozeman MT 59715

Bureau of Land Management
Montana State Office
222 North 32nd Street
PO Box 36800
Billings MT 59107

Department of Fish, Wildlife and Parks
1400 South 19th
Bozeman MT 59715

Department of Natural Resources and Conservation
Water Rights Bureau
151 Evergreen Drive, Suite C
Bozeman MT 59715

Gallatin County Planning Office
311 W. Main, Room 200
Gallatin County Courthouse
Bozeman MT 59715

Gallatin National Forest
Federal Building
Bozeman MT 59715

Bozeman Ranger District
3710 Fallon
Bozeman MT 59715

Soil Conservation Service
3710 Fallon
Bozeman MT 59715

State Department of Commerce
Cogswell Building, Room C-211
Helena MT 59620

Department of Health and Environmental Sciences
Water Quality Bureau
Cogswell Building, Room A 2
Helena MT 59620

Montana Department of State Lands
611 North Wallace
Bozeman MT 59715

Montana Department of Highways
907 North Rouse
Bozeman MT 59715

APOPTION:

The update to this plan was amended by Resolution No. 1999 - 01 of the Gallatin County Zoning Commissioners on January 14, 1999, and by Resolution No. 1999 - 01 of the Gallatin County Commissioners on January 26, 1999.

Gallatin County Zoning Commission:

Shelley Vance, Chairman

William A. Murdock, Member

Jeffrey Krauss, Member

Phil Olson, Member

Jennifer Smith Mitchell, Member

Gallatin County Commission:

William A. Murdock, Chairman

Phil Olson, Member

Jennifer Smith Mitchell, Member

ATTEST:

Shelley Vance, Clerk & Recorder

THIS PLAN WAS AMENDED BY RESOLUTION NO. 1995-25 OF THE GALLATIN COUNTY COMMISSIONERS ON MAY 16, 1995.

THIS PLAN WAS AMENDED BY RESOLUTION NO. 1995-52 OF THE GALLATIN COUNTY COMMISSIONERS ON OCTOBER 13, 1995.

THIS PLAN WAS AMENDED BY RESOLUTION NO. 1996-4 OF THE GALLATIN COUNTY COMMISSIONERS ON JANUARY 16, 1996.

THIS PLAN WAS CORRECTED ON AUGUST 8, 1997, BY DIRECTION OF THE GALLATIN COUNTY ATTORNEY'S OFFICE TO CHANGE THE WORD "*ORDINANCE*" TO "*REGULATION*" THROUGHOUT THIS DOCUMENT.

THIS PLAN WAS AMENDED BY RESOLUTION NO. 1999-01 OF THE GALLATIN COUNTY COMMISSIONERS ON JANUARY 26, 1999.

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